Appendix H1
Cabrillo Port Ichthyoplankton Impact Analysis

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January 2007

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1.0 INTRODUCTION

The Cabrillo Port Liquefied Natural Gas (LNG) Deepwater Port (the Project) proposed by BHPB Billiton LNG International, Inc. (BHPB, the Applicant) would contain systems requiring the use and uptake of seawater. These systems would include ballast water exchange for the floating storage and regasification unit (FSRU), cooling and fire safety, and potable water systems. Together, these systems would require the uptake and use of a weighted annual average of approximately 4.17 million gallons per day (MGD) (approximately 15,785 cubic meters [m^3]) of seawater**.** The intake for the entire volume of seawater required by these systems would be within waters surrounding the FSRU.

The purpose of this study is to gather and evaluate additional ichthyoplankton data to further support the analysis and conclusions in the Draft EIS/EIR, including seasonal and diurnal variations in the local community that could be impinged or entrained as the FSRU takes in seawater. Impingement is a term that describes the process that may occur when fish and other aquatic life are trapped against cooling water intake screens. Entrainment is a term that describes the process that may occur when aquatic organisms, eggs, and larvae are drawn into a seawater system, through the pipes and pumping systems, and then pumped back out. The proposed Project has changed since issuance of the March 2006 Revised Draft Environmental Impact Report (EIR). The previously proposed FSRU generator engine cooling system used seawater as the source of cooling water for the four generator engines. The Applicant now proposes using a closed tempered loop cooling system that circulates water from two of the eight SCVs through the engine room and back to the SCVs. The seawater cooling system would serve as a backup system during maintenance of the SCVs or when the inert gas generator is operating.

This report contain detailed information regarding the proposed Project systems requiring the uptake of seawater and how the seawater use has decreased as a result of Project design modifications; the methodology used for the analysis of impacts on ichthyoplankton from seawater uptake (including source water body identification, calculations, data procurement, and calculations); and the results and discussion of potential impacts. Section 2.0 summarizes the findings. Section 3.0 contains an overview of the proposed Project and the associated seawater uptake systems, including ballast water and other uptake systems. Section 4.0 contains specific information on development of the methodology, consultations conducted, source water body identification, associated calculations for water volumes in the Project area, and data procurement. Section 5.0 provides information on the results of the ichthyoplankton densities in the Project area, numbers of ichthyoplankton impacted by the Project, special status species occurring within the Project area, and relative mortality calculations. Conclusions are located in Section 6.0. Contact information is in Appendix H1-1. Due to the extensive amount of data in the tables, all except Tables 1, 3, and 4 are provided in Appendix H1.2.

2.0 SUMMARY OF FINDINGS

The density of ichthyoplankton in the Project area is low, as is typically expected in offshore areas. The densities are well distributed among species, and no individual species is dominant in the Project area. The number of eggs and larvae entrained as a result of ballast water and other system intakes would be very small relative to the abundance of marine organisms in the surrounding waters, so that even assuming 100 percent mortality, the resulting mortality based on the weighted average seawater intake of 4.17 MGD would be 42,704 eggs and 7,614 larvae per day, representing <0.00000019 percent of the 21,464,100,000,000 eggs and 3,824,100,000,000 larvae found within the quadrat.

In addition to the weighted average, the minimum and maximum operating conditions were also evaluated for comparative purposes. The minimum operating condition assumed operations 322 days per year and a seawater intake of approximately 3.93 million gallons per day. This resulted in entrainment values of approximately 40,169 eggs and 7,162 larvae per day.

The maximum operating condition assumed operations four days per year and a sea water intake of approximately 16.33 million gallons per day, This resulted in entrainment values of approximately 166,963 eggs and 29,768 larvae per day.

Based on the California Cooperative Oceanic Fisheries Investigations (CalCOFI) data used in this assessment, species managed by the Pacific Fishery Management Council make up approximately 49,713,300 larvae, or 0.000013 percent of the total larval density, and 214,641,000 eggs, or 0.000010 percent of the total egg density estimated to be present in the source water body. Based on the small numbers of these species expected to be entrained in the seawater uptake systems, the impacts on these species would be less than significant (see Section 4.7 of the Final EIS/EIR for further information on impacts to managed fish species).

The results of this analysis confirm the stated conclusions presented in the March 2006 Revised Draft EIR and the Final EIS/EIR that the proposed Project would not have a significant impact on ichthyoplankton. Although no consensus currently exists within the scientific community or responsible agencies regarding what level of impacts on ichthyoplankton are considered significant, the density of ichthyoplankton within the Project area represents typical low-level values expected in offshore areas.

3.0 OVERVIEW OF THE PROJECT

The proposed Project would include the construction and operation of a new offshore FSRU, offshore and onshore pipelines, and related onshore facilities. LNG carriers would transport LNG to the FSRU where it would be stored, regasified to its original gaseous form, and then distributed via pipeline throughout the Southern California region. The FSRU would be moored in Federal waters, about 12.01 nautical miles (NM)

(13.83 miles or 22.25 kilometers [km])[1] offshore of Ventura County and Los Angeles County, California. The Applicant's stated Project design life is 40 years, although the Federal license for the proposed deepwater port would have no expiration date.

The total LNG storage capacity on the FSRU would be approximately 72 million gallons (272,520 m^3). The FSRU would receive approximately one to two LNG shipments per week, depending on the size of the LNG carrier used. All ballasting operations would be in accordance with International Convention for the Prevention of Pollution from Ships (MARPOL), State, and United States Coast Guard (USCG) regulations and protocols.

3.1 FSRU SYSTEMS REQUIRING UPTAKE OF SEAWATER

The systems requiring the use and uptake of seawater include ballast water exchange for the FSRU, cooling and fire safety, and potable water systems. Based on FSRU design changes implemented since publication of the March 2006 Revised Draft EIR, on-board systems would use approximately 4.17 million gallons per day (MGD) (approximately 15,785 m^3) of seawater. This value is based on a weighted average annual value which was derived from the minimum operating condition of 3.93 MGD occurring 322 days per year and the maximum operating condition of 16.33 MGD occurring four days per year. The operational days per year when a seawater intake would not occur were not included in the weighted average calculation since considering "0" in the average would further reduce the value and using only the actual operational days represents and more conservative estimate of seawater intake and potential ichthyoplankton impacts from entrainment.

The details for the water use operating conditions are presented in the WorleyParsons Sea Water System Operations and Design Features Report and Seawater Cooling Elimination Report (Appendices D5 and D6). The FSRU would operate under four different scenarios:

- **Scenario 1: Ballast operation during gas export only.** This operation would occur 322 days per year when the FSRU would be regasifying the LNG and exporting natural gas. The FSRU would take on ballast water in order to maintain the FSRU on even keel. Approximately 94,300 gallons per day (357 m^3/d) of freshwater generated by the submerged combustion vaporizers (SCVs) would be directed to the ballast water, reducing the necessary ballast water intake to 3,930,000 US gallons per day (14,900 m^3/d). The net water ballast intake requirement would 1,266,000,000 gal/yr (4,791,000 m^3/yr) for this mode of operation.

- **Scenario 2: Ballast operation during simultaneous gas export and LNG loading.** In this operating mode, the FSRU would discharge ballast water. The rate that LNG would load on the FSRU would be greater than the weight of the natural

[1] This EIR uses nautical miles (NM) as the preferred unit for all large distances referred to in offshore discussions and statute miles for all large distances onshore (1 NM ≈ 1.15 statute miles or 1.85 km). Metric units are also given. A list of acronyms and abbreviations is provided after the Table of Contents.

gas that would be regasified and exported. The FRSU would discharge ballast water at a rate of 1,564,000 gallons per hour (5,920 m^3/h). At the same time, the LNG carrier would take on board sea water for ballast at a rate of 1,740,000 gal/h (6,600 m^3/h) and for cooling water at a rate of 187,600 gal/h (710 m^3/h). This operation occurs for 13 hours per offload and based on a 210,000 m^3 LNGC; the frequency of offloads is 65 times per year. For a smaller LNGC size of 138,000 m3 of LNG, the offload time is 8.5 hours and 99 offloads per year are required. This is equivalent to 35 days of continuous LNG transfer per year for both the 210,000 m3 LNGC (13 hrs x 65 offloads) and the 138,000 m3 LNGC (8.5 hrs x 99 offloads). The number of equivalent days is independent of the LNG carrier size and is based on the FSRU's LNG vaporization capacity. The total ballast discharged overboard by the FSRU over the 13 hour transfer period would be 20,340,000 gal (77,000 m^3) and the LNGC would take onboard 22,570,000 gal (85,440 m^3) of ballast water.

- **Scenario 3: Ballast operation during gas export and IGG operation** - During this scenario, the FSRU would be exporting natural gas as at the same rate as described in Scenario 1; the IGG system would also be operating. Sea water would be used for ballast and cooling for the IGG system. The volume of ballast seawater is 3,930,000 US gal/d (14,900 m^3/d) and the volume of IGG cooling water is 10,440,000 US gal/d (39,500 m^3/d). This operation would occur on average for 4 days per year.

- **Scenario 4: Ballast operation during gas export and backup seawater cooling -** During this scenario, the FSRU would be exporting natural gas as at the same rate as described in Scenario 1; the backup seawater system also would be in operation to cool engine room equipment. The back-up sea water system would be required when the two SCVs that would be used in the closed loop tempered water system are under maintenance. The volume of ballast seawater would be 3,930,000 US gallons/day (14,900 m^3/day) and the volume of back up seawater cooling water would be 4,355,000 US gal/d (16,500 m^3/d). This operation would be expected to occur for 4 days per year on average.

Table 1 summarizes water use estimates under each FSRU operating scenario.

Table 1: Potential Operating Scenarios and Associated Seawater Use

Operating Scenario	Days per Year	Gas Export Rate in MMscfd	Water Use	gallons per day	cubic meter conversion	gallons per year	cubic meter conversion
Scenario 1	322	800	ballast	***3,930,000***	14,877	1,265,460,000	4,790,287
		1,200	ballast	5,895,000	22,315		
Scenario 2	65		LNG carrier ballast	1,740,000	6,587	1,470,300,000	5,565,691
			LNG carrier cooling	187,600	710	158,522,000	600,071
			Total Scenario 2	1,927,600	7,297		

Operating Scenario	Days per Year	Gas Export Rate in MMscfd	Water Use	gallons per day	cubic meter conversion	gallons per year	cubic meter conversion
Scenario 3	4	800	ballast	3,930,000	14,877	15,720,000	59,507
			IGG	10,440,000	39,520	41,760,000	158,079
			Total Scenario 3	14,370,000	54,396	57,480,000	217,585
Scenario 3	4	1,200	ballast	5,895,000	22,315	23,580,000	59,507
			IGG	10,440,000	39,520	41,760,000	158,079
			Total Scenario 3	***16,335,000***	61,835	65,340,000	
Scenario 4	4	800	ballast	3,930,000	14,877	15,720,000	59,507
			cooling	4,355,000	16,485	17,420,000	65,942
			Total Scenario 4	***8,285,000***	31,362	33,140,000	
Scenario 4	4	1,200	ballast	5,895,000	22,315	23,580,000	59,507
			cooling	4,355,000	16,485	17,420,000	65,942
			Total Scenario 4	***10,250,000***	38,800	41,000,000	

Notes:

Values in bold and italicized print represent the minimum and maximum water use volumes that were used to evaluate potential ichthyoplankton impacts based on a weighted average water use for the year of 4.17 million gallons per day.

Key:

MMscfd = million standard cubic feet per day; IGG = inert gas generator

3.1.1 Ballast Water Systems

Ballast water exchange is required to maintain the balance and floating depth (draft and trim) of the FSRU, for example, when LNG carriers are unloading LNG to the FSRU. The FSRU would load and discharge seawater to and from ballast tanks via a system of dedicated pumps, pipelines, and valves that together would comprise the ballast system. This piping system would commence at through-hull opening fittings called sea chests, which would connect via pipelines and valves to the ballast pumps. The exchange of ballast water would occur at the bottom of the FSRU's hull at a depth of 42.7 feet (13 m).

The ballast pump configuration proposed provides a maximum pumping capacity of 6,000 m^3 of water per hour. Project engineers analyzed the seawater intake under normal conditions (800 million standard cubic feet per day [MMscfd] gas export rate) and the maximum gas export case of 1,200 MMscfd. Under normal operating conditions the total seawater intake would be approximately 14,900 m^3 per day (or 6.07 ft^3 per second). The required sea chest intake area would be 33.2 ft^2, and the actual sea chest intake area would be 47.6 ft^2. Based on the proposed arrangement and location of the sea chests and uptake valves, the seawater uptake velocity would remain equal to or less than 0.5 feet/second (Moss Maritime 2005). Ballast water intakes would be screened and flow rates would be maintained in accordance with the Clean Water Act 316(b) Phase III final rule (40 CFR parts 9, 122, 123, 124, and 125), i.e., flow rates of less than 0.5 feet per second, to minimize entrainment of aquatic organisms. An external coarse filter grill and a secondary fine filter screen are proposed for use on the sea chest. The ichthyoplankton analysis does not account for the biological effectiveness of these screens; the ichthyoplankton impact analysis assumes

100 percent mortality and an unscreened intake, and thus results can be considered conservative.

Ballast Water Exchange Volumes for FSRU

The FSRU would be constantly exchanging ballast water to maintain draft and trim during both loading of LNG from LNG carriers and export of natural gas to shore. Ballast water exchange would use a computer-controlled ballast water management system that is designed to constantly monitor load conditions and either take in or discharge seawater as necessary. At all times, except during LNG carrier loading into the FSRU, ballast water would be taken onto the FSRU at an average rate of 2,895 gallons per minute to compensate for the volume of natural gas being transported ashore via the subsea pipeline. This is based on a natural gas send out rate of 800 MMscfd, which is the average daily amount of natural gas production. During loading operations from the LNG carriers, the FSRU would discharge a maximum of 20.33 million gallons (76,957 m^3) of ballast water per shipment received. As the LNG is regasified aboard the FSRU and sent to shore, seawater would be pumped into the ballast tanks to supplement the loss of LNG volume and to maintain draft and trim of the FSRU. The ballast water would be obtained from and discharged to the ocean in the same location adjacent to the FSRU and no chemicals would be added; therefore, treatment of the ballast water prior to discharge would not be necessary.

3.1.2 Other Seawater Requirements for the FSRU

Several other operational and maintenance activities on the FSRU would require the use and uptake of seawater. Although specific design plans have not been finalized, a typical vessel of this type would have the following seawater uptake systems, totaling eight sea chests and six intakes:

- Ballast water – two sea chests with one intake supplying both;
- Cooling water – two sea chests with one intake supplying both; and
- Fire system – two sea chests forward; two sea chests aft, each with its own intake (four intakes).

All eight intakes would be at a depth of approximately 43 to 45 feet and would maintain flow rates of less than 0.5 feet per second. For additional details on the design changes to the seawater intake systems and cooling water operations on the FSRU, see the Sea Water System Operations and Design Features Report (Appendix D5).

4.0 METHODOLOGY

The overall goal of the analysis was to calculate and analyze the potential impacts the ballast water and other seawater uptakes would have on ichthyoplankton. This analysis is based on seawater requirements of the cooling and seawater intake system and has incorporated the Project design changes on the FSRU and its cooling system made subsequent to the March 2006 Revised Draft EIR, resulting in a 60 percent decrease in seawater intake volume.

In order to complete the analysis, information on ichthyoplankton abundance and density, and taxonomic data for the area of potential impact, or *source water body,* near the FSRU needed to be obtained. Initially, site-specific ichthyoplankton sampling was considered to determine species distributions and densities in the proposed Project site. However, long-term complete data sets already exist through the CalCOFI database, and conducting additional sampling would have had several drawbacks. Point-in-time ichthyoplankton sampling at the Project site would result in a very short-term data set, potentially representing as little as one or two seasons and at the most one year of data. Even one full year of data would not provide sufficient information on seasonal or yearly variations in species densities or composition. Additionally, data obtained from such sampling could potentially produce erroneous results if they were influenced by any relatively short-term phenomenon, such as El Niño/La Niña weather patterns or other localized marine or weather patterns. Based on the above constraints, and based on the availability of long-term, Project area-specific data (discussed below and in Section 4.4, Data Procurement), site-specific ichthyoplankton sampling was rejected.

After consultation with experts from CalCOFI, it was determined that long-term data, including seasonal variations, were readily available from the CalCOFI database. The CalCOFI is a partnership of the California Department of Fish and Game, the National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the Scripps Institution of Oceanography. The organization focuses on the study of the marine environment off the coast of California and the management of its living resources. Since 1949, CalCOFI has conducted cruises to measure the physical and chemical properties of the California Current System and to census populations of marine organisms, including ichthyoplankton. CalCOFI is considered the foremost observational oceanography program in the United States. Currently, two- to three-week cruises are conducted quarterly. On each cruise, a grid of 66 stations off the Southern California coast are sampled for a suite of physical and chemical measurements to characterize the environment and to map the distribution and abundance of phytoplankton, zooplankton, and fish eggs and larvae.

Using the data provided by CalCOFI, the Project team calculated the mean number of eggs and larvae per cubic meter of seawater, then converted the results to numbers of individual eggs and larvae per gallon. The number of individual eggs and larvae per gallon was used to determine the number of individual eggs and larvae per million gallons. The seawater intake volumes for the FSRU were then used to calculate the average daily entrainment numbers.

To determine the relative effect of loss of egg and larvae, the source water body volume was determined. Then the number of eggs and larvae within the source water body was calculated, and lastly, the relative number of eggs and larvae entrained compared to the volume of water was computed as a percent predicted to be lost.

A modified version of the Empirical Transport Model (ETM) (Boreman et al., 1978; 1981) was used to predict loss from larval entrainment based on the calculation of the *conditional mortality* rate. *Conditional mortality* refers to the fraction of the larval population in the source water body that is lost due to entrainment factors only, and not considering other sources of mortality. The model compares the estimated number of organisms potentially entrained to the estimated number of individuals known to exist in the source water body. This modified analysis does not compare like-species to like-species, but instead compares total ichthyoplankton densities known to occur in the source water body to the ichthyoplankton densities potentially entrained. Modified ETM methods have been used in California to predict impingement and entrainment impacts for power plant cooling water intake structures (California Energy Commission 2004). The following provides a summary of the methodology used to develop the analysis.

4.1 CONSULTATIONS

In order to develop an analysis that would satisfy the data and evaluation requests of the California Coastal Commission (CCC), as well as take into consideration the most current scientific methods, the Project team consulted with agencies, organizations, and marine scientists. Consultations were conducted before, during, and after completing the initial ichthyoplankton analysis and following publication of the March 2006 Revised Draft EIR. Results of consultations are incorporated into the final ichthyoplankton analysis presented here. Appendix H1.1 contains a summary of the information obtained during the consultation process. CalCOFI staff members were consulted during the development of this methodology for information on available data, sampling methods and depths, and general knowledge of the Project area. Additionally, the CCC was consulted during development of this methodology, and the proposed methodology was submitted to the California State Lands Commission and the USCG for review and comment prior to implementation. Following publication of the March 2006 Revised Draft EIR, experts from the University of California at Santa Barbara were contacted regarding the approach taken to determine the source water body for use in developing the ichthyoplankton impact calculations.

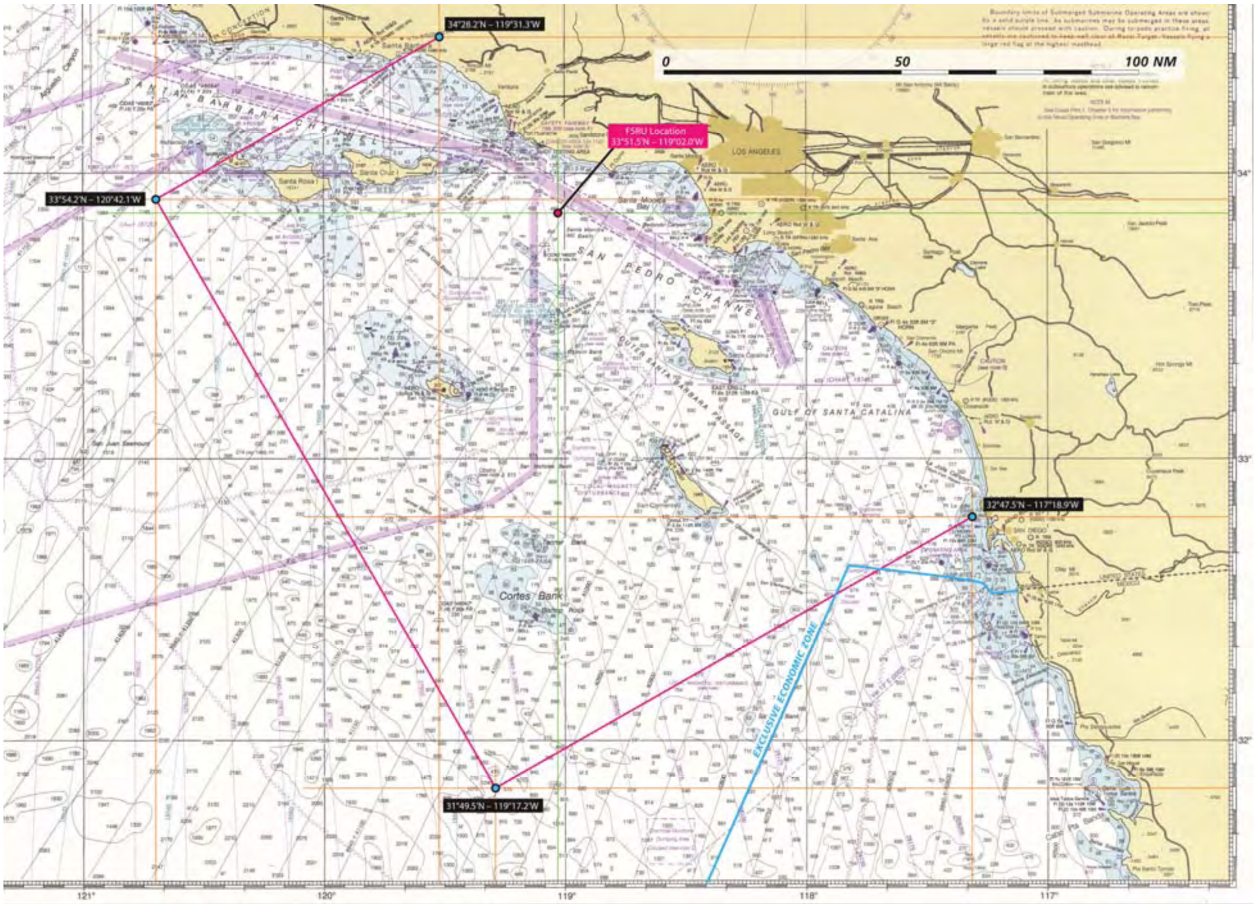
4.2 CALCULATION OF BALLAST WATER VOLUMES

The above information on the FSRU ballast water system and other operational seawater uptake systems was used to determine the volume of seawater taken into the FSRU at the Project site. These volumes were then used, together with ichthyoplankton density data obtained from CalCOFI, to analyze potential impacts. See Tables 2a and 2b for volumes and calculations for projected seawater intake volumes.

4.3 IDENTIFICATION OF THE SOURCE WATER BODY

In order to compare the estimated numbers of individual eggs and larvae potentially entrained to the number of individual eggs and larvae at risk of entrainment, i.e., present in the Project area, for the modified EMT Model, the Project team identified the *source water body*. The *source water body* refers to the volume of water in an estimated area that is subject to potential impingement and entrainment impacts. The Project team identified an appropriate quadrat in the area surrounding the FSRU that has the potential to contain ichthyoplankton that may be affected by the proposed Project's seawater intake systems (see Figure 1).

Figure 1. Source Water Body Area Containing Ichthyoplankton Potentially Impacted by the Project



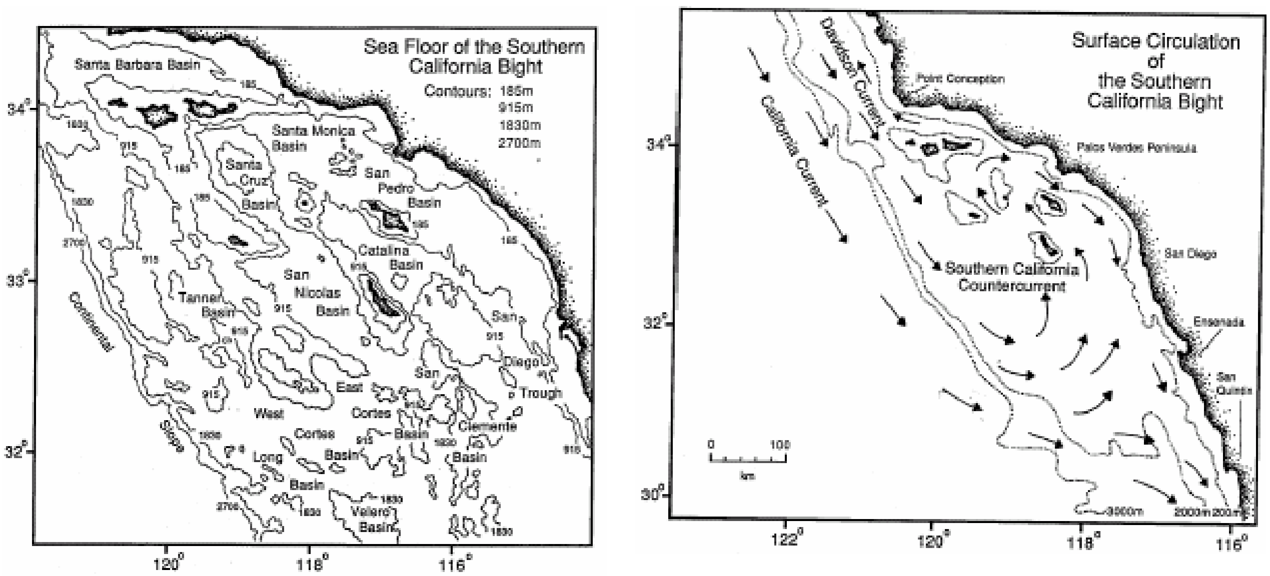
Sources: NOAA 2003; Ecology and Environment, Inc. 2005.

To determine the source water body, a literature search was performed to identify the physical (currents, bathymetry, water chemistry, etc.) and biological factors that would indicate the location, densities, and species of ichthyoplankton. Because ichthyoplankton are carried by the currents in the water column at the depths where they exist, the circulation patterns in the Project area were identified. Circulation patterns, including direction and velocity, are also influenced by the bathymetry and depth in the area. The quadrat was identified based on the known vertical and horizontal migration patterns of ichthyoplankton, bathymetric contours, and surface water circulation at the depths at which ichthyoplankton occur within the proposed Project area.

4.3.1 Determination of the Source Water Body Area

The FSRU would be located approximately in the center of the Southern California Bight (SCB), a region that includes coastal Southern California, the Channel Islands and the local portion of the Pacific Ocean. Figure 2 shows the bathymetric contours in the SCB and the areas beyond the Project area. Bathymetry in the SCB is defined by submarine canyons, basins, and ridges caused by movements along the San Andreas Fault System. Figure 3 shows the generalized surface circulation within the SCB and proposed Project area. The prevailing surface currents are the California Current, a generally slow moving current which flows southeastward off the coast, and the Southern California Counter Current, which flows northerly up the coast between the California Current and the coastline and is diverted by the northern Channel Islands. This dynamic creates a large, highly variable (in velocity and season) counterclockwise gyre (or spiral) within the Project area for most of the year. As shown in Figure 3, this gyre would contain ichthyoplankton that may be carried into the Project area and specifically, into the seawater intake area.

Figures 2 and 3. Bathymetry Contours and Surface Circulation of the Southern California Bight



Source: Dailey et al., 1993.

Currents near the proposed site are typically northward in summer, fall, and winter, whereas in spring there is an onshore flow. Table 3 summarizes the basic characteristics of these currents. These velocity estimates are typically slower than currents measured at the eastern entrance to the Santa Barbara Channel, approximately 16 NM (18 miles or 30 km) to the northwest. Flows south of the proposed Project have higher recorded current speeds below the water surface during the spring.

Table 3 Characteristics of Currents near the Proposed Project

Season	Direction	Surface Speed
Summer	Northward	0.14 knots (0.16 mph or 7 centimeters/second [cm/s])[a]
Fall	Northward	0.019 knots (0.022 mph or 10 cm/s)[a]
Winter	Northward	0.097 knot (0.11 mph or 5 cm/s)[a]
Spring	Onshore	0.06 knot (0.07 mph or 3 cm/s)

[a] Bray et al. 1999.

Oceanographic conditions in the vicinity of the proposed Project shift from upwelling, poleward push and equatorward push on a 20- to 25-day cycle. When winds and the currents are southward, upwelling can occur near Point Conception and near Point Dume. During upwelling, colder water is found near the coast and across the Santa Barbara Channel. When this occurs, water at the proposed site would flow southward from the Santa Barbara Channel. In the absence of upwelling, currents flow northward at the proposed site. This represents a poleward push in which warmer water from the south travels northward. If this current weakens or reverses, an equatorward push can occur. In a push toward the equator, colder water flows from the north, and an equatorward flow occurs past the Project site. During upwelling, poleward push, and equatorward push, currents fluctuate approximately 0.2 knots (0.22 mph or 10.3 cm/s).

In the area of the proposed FSRU, tidal currents vary from 7.5 to 16 feet per minute (0.074 to 0.16 knots or 3.8 to 8.3 cm/s) and generally flow from the northwest to the southeast. In general, the northwest/southeast tidal current ranges in velocity from 4.5 to 8.8 feet per minute (0.044 to 0.087 knots or 2.3 to 4.5 cm/s), with the highest velocities 250 feet (76 m) beneath the surface (Münchow 1998).[2]

Based on the above information, the source water body used in the analysis to calculate source water body volume is defined by the quadrat enclosed by four corner points identified by the latitudes and longitudes shown in Table 4. The farthest distance in the quadrat from the FSRU seawater intake is 145 NM (167 miles) south. Based on the surface current velocities in the Project area, and as a conservative estimate, it would take approximately 31 days for ichthyoplankton to be carried to the intake valve from the farthest point in the quadrat. This area was identified as the area that contains species and individuals that exist in the proposed Project area and have the potential to be carried into the proposed seawater intake systems by currents and affected by entrainment. Using a smaller quadrat or using data from only one station would severely limit the density and number of species identified and would not provide an accurate account of the species potentially entrained by the proposed Project.

Table 4 Quadrat Location

Corner/Feature	Latitude	Longitude
N	34 28.2N	119 31.3W
W	33 54.2N	120 42.1W
S	31 49.5N	119 17.2 W
E	32 47.5N	117 18.9W
FSRU	33 51.518N	119 02.015W

[2] These current speeds were derived from conventional harmonic analysis and, therefore, do not include the total contribution of internal tides. Internal tides are generated by the interaction of the surface tides with bathymetry.

Following publication of the March 2006 Revised Draft EIR, experts from the University of California at Santa Barbara were contacted regarding the approach taken to determine the source water body for use in developing the ichthyoplankton impact calculations. These contacts resulted in a general concurrence that the approach used for the analysis was appropriate (Love and Washburn contact reports in Appendix H1-1; Scripps 2006).

Once the source water body quadrat was identified, the depth at which ichthyoplankton are known to occur (vertical distribution) was determined through existing data and literature in order to calculate the source water body volume (see Section 4.4 below). Ichthyoplankton occur in the water column to depths of 300 m (or slightly more) depending on the environment and the species requirements (Moser et al, 1993, 1999, and 1997; Schlotterbeck et. al 1982; Sakuma et. al 1999). A literature search was performed, including additional consultation with the CalCOFI, to identify all available data on vertical distribution of ichthyoplankton. Table 5 shows the available data for vertical distribution available in the literature for species potentially occurring within the SCB.

Vertical distribution data is only available for 29 species out of the 113 species identified in the ichthyoplankton analysis; however, these data indicate that species occur at various depths and exhibit widely variable seasonal distributions and migration patterns in the water column. For example, Pacific hake was identified by one study at all strata down to 820 feet (250 m), with the highest densities below 164 feet (50 m). Another study indicated that ichthyoplankton of rockfish species are generally found above the pycnocline[3], but are highly variable. Generally, rockfish larvae typically occurred in the upper 262 feet (80 m); highest densities were in the 131-262 feet (40-80 m) stratum offshore, with extremely low densities in the upper 98 feet (30 m). Additionally, certain species exhibit vertical migration patterns where they move between depths at various points during the day (daylight hours, evening hours, or at dawn and dusk) in response to daylight or predator/prey presence. The Cabrillo Port ichthyoplankton analysis was developed based on the best available data within the proposed Project area; however, these data are inadequate for use in analyzing density at various depths from the CalCOFI data set. Furthermore, the variable depths of the ichthyoplankton indicated in the literature (see Table 5) confirm that ichthyoplankton occur at all depths up to 984-1,312 feet (300-400 m) in the proposed Project vicinity.

Because limited data and literature are available pertaining to species stratification (specific depths at which individual species occur within the water column) in the SCB, the source water body was restricted to a 210-meter water depth corresponding to the CalCOFI sample depths and the information available in the literature regarding the depth of ichthyoplankton occurrence in the proposed Project area.

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[3] A pycnocline is a layer of rapid change in water density with depth. In oceans this is mainly caused by changes in water temperature and salinity.

4.3.2 Determination of Source Water Body Volume

Two GIS data layers were used to calculate the water volume within the Project area:

- The Project area boundary; and
- US Pacific bathymetry raster grid at a 200 m cell resolution.

Raster commands in Environmental Systems Research Institute's ArcGIS software were used to calculate the total water volume within the quadrat. First, the US Pacific bathymetry was clipped to the Project area boundary so that only depths within the Project area were considered. Next, the ArcGIS 'Surface Volume' command was used to generate the difference in depth between the water surface and a depth of 210 meters (or less due to depth in shallower areas) corresponding to the depth of the CalCOFI sampling depths. A text file was generated by the Surface Volume command that listed the total volume.

A double check of the value calculated in ArcGIS was completed by totaling the number of 200 m cells at each depth, calculating the total surface area (200 m x 200 m) at each depth, and then calculating the volume at each depth by multiplying the area by depth. The resulting volumes were added together to determine the total Project area volume. Figure 4 outlines the steps taken to arrive at a total water volume. The calculation is also outlined in the ArcGIS 9.0 Toolbox Model.

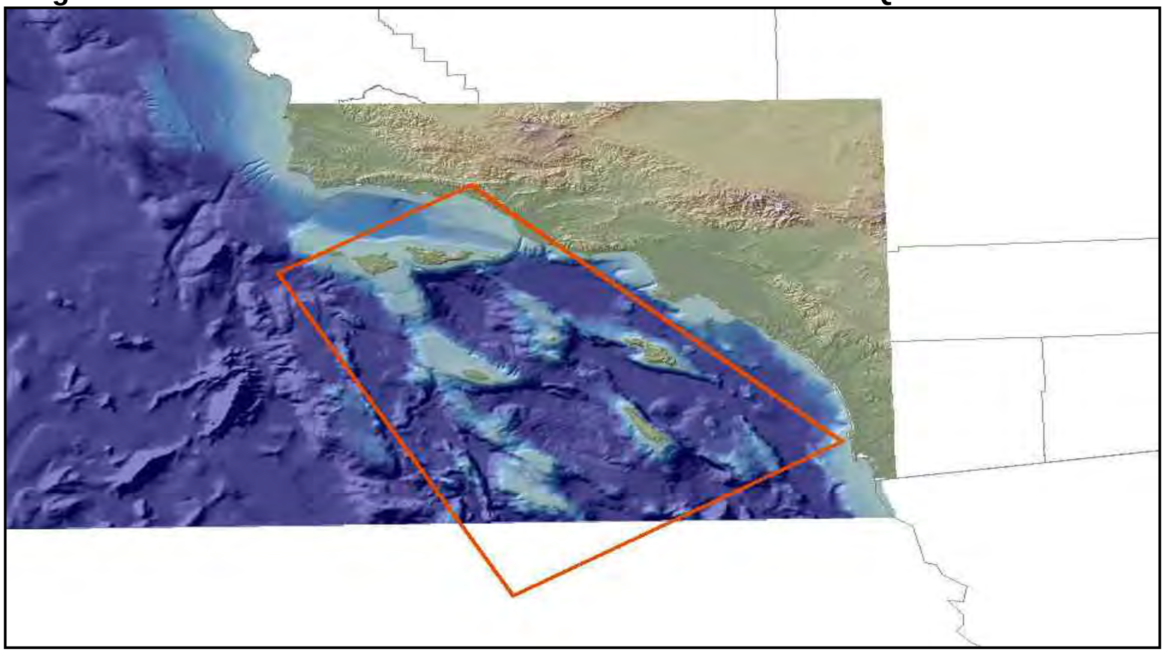
4.4 DATA PROCUREMENT

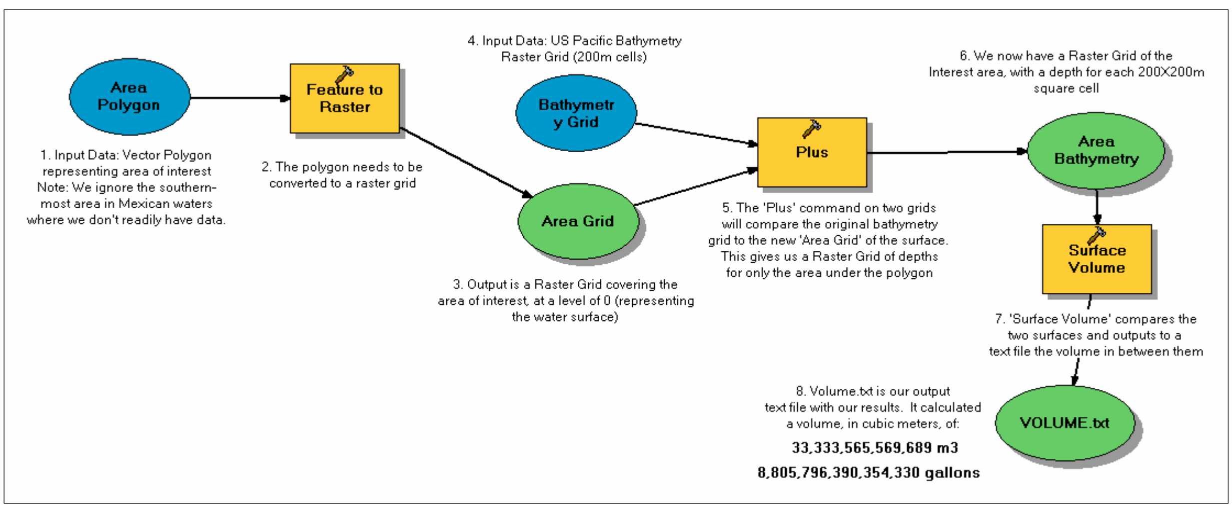
Based on its understanding of environmental variables and identification of the source water body, including prevailing currents near the facility site and depth strata, the Project team provided CalCOFI with the quadrat location (corner latitudes and longitudes, and graphic representation). CalCOFI then identified sampling stations within the quadrat that provided relevant data for the ichthyoplankton analysis. The Project team submitted a request for ichthyoplankton data for these stations (larvae and egg data in the form of number per cubic meter of water) to the NOAA Fisheries.[4] Based on the source water body quadrat provided, NOAA sorted the database for stations that fell within quadrat limits, and then sorted and calculated ichthyoplankton densities based on the amount of water that was filtered during each sampling run. The Project team obtained the most current CalCOFI data available (2000–2004) for 386 ichthyoplankton sampling events from 14 stations located within the identified quadrat from the CalCOFI database.

Figure 5 provides a map of the CalCOFI stations identified as containing data relevant to this analysis and the location of the FSRU and subsea pipeline. Data from all stations were combined. The species variability between stations is not of concern because it has been determined that data from all stations identified by the CalCOFI staff are relevant to determining Project entrainment impacts. Additionally, because the

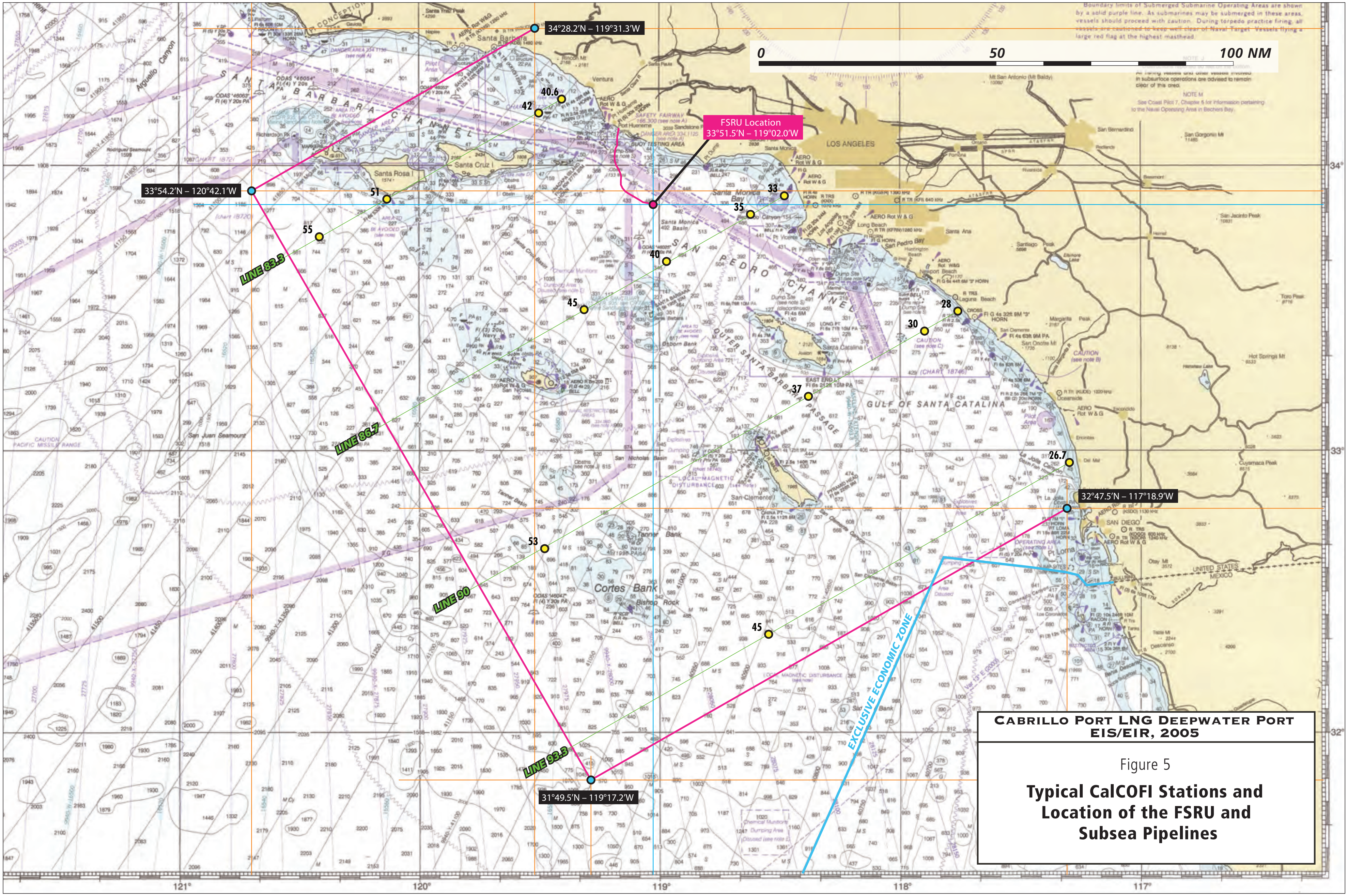
[4] Consultations were conducted with Mr. Richard Charter (NOAA) when obtaining CalCOFI data.

Figure 4. Process for Determination of Water Volume within Quadrat





Source: Ecology and Environment, Inc. 2005.



CABRILLO PORT LNG DEEPWATER PORT
EIS/EIR, 2005

Figure 5

Typical CalCOFI Stations and Location of the FSRU and Subsea Pipelines

CALCOFI Bathym_rev1_A4 sz.ai 09/01/2005

data were obtained from multiple sampling events spread over a number of years and multiple seasons, the data represent seasonal and annual variations that may occur in the density and species distribution of ichthyoplankton in the Project area.

Table 6a provides a complete list of the 386 samples (sampling events), including cruise number, station and line number, and latitude and longitude for each. Table 6b provides information on the location and station number of each of the 14 stations. Data obtained from each station included the number of eggs and larvae per cubic meter of water for each station, the species found at each station, and the total number of fish larvae per 10 square meters of surface seawater. Additionally, based on the bathymetric contours and surface water circulation patterns in the Project area, it was determined that data from all stations were relevant in determining potential FSRU ballast water entrainment, and that seasonal variability and/or variability between stations are included in the calculations of average densities.

5.0 RESULTS AND DISCUSSION

5.1 ICHTHYOPLANKTON DENSITIES

Data obtained from the NOAA Fisheries/CalCOFI database included the number of eggs and larvae per cubic meter of water for each station, the species found at each station, and total number of fish larvae per 10 square meters of surface seawater. The Project team summed and averaged the number of eggs and larvae per cubic meter of water, i.e., per 386 samples from 14 stations, to determine the mean number of eggs and larvae that would occur in a cubic meter of water. Table 7 provides this information by CalCOFI station number and sampling date. After the mean number of eggs or larvae per cubic meter of seawater was obtained, this value was converted to number per gallon and then multiplied to determine the number per million gallons. The average and maximum water intake volumes for the FSRU were used to calculated daily entrainment numbers.

To determine the relative loss of ichthyoplankton eggs and larvae, the sampling area volume was determined using digital GIS mapping capabilities and the known bathymetric data profiles within the geographical limits of the quadrat. Figure 4 outlines the steps taken to arrive at a total water volume. The calculation is also outlined in the ArcGIS 9.0 Toolbox Model. Based on these calculations, over 7.8 trillion m^3 of water exist within the Cabrillo Port quadrat. This equals approximately 2.1 quadrillion gallons of seawater.

The total number of eggs and larvae per cubic meter of seawater within the 7.8 trillion m^3 of water was then determined (see bottom of Table 7). This number was used to calculate the average egg and larvae densities per million gallons of seawater. Table 7 provides the results of these calculations as sums and averages (see bottom of table).

The relative number of entrained ichthyoplankton eggs and larvae compared to the source water body volume was then calculated. This calculation represents the ichthyoplankton density predicted to be lost due to entrainment. Some scientists believe that the standard methods of sampling ichthyoplankton using a 0.333 millimeter mesh net can result in density values lower than actual values due to extrusion of smaller specimens through the net. In order to provide a more conservative calculation and to avoid underestimating the densities of ichthyoplankton potentially impacted by the Project, a multiplier of 3 was applied to the calculated ichthyoplankton densities based on methods previously proposed by NOAA (Thompson 2004) to adjust for potential sampling inefficiency due to extrusion. The results of this adjustment are presented in Table 8.

Ichthyoplankton species assemblage information was developed using a similar approach. The composite values for each taxonomic group for all stations combined were determined. Then the relative (%) position of that taxonomic group (compared to all others) was determined to show which group(s), over the period of the samples used, would be expected to occur in the Project area from the highest to lowest densities. The Project team sorted the data for each station by taxonomic grouping, including subfamilies or genus species as appropriate, and overall abundance for each taxa identified. Tables 9a and 9c present occurrence of taxa within the database from those found most often to those found least often for larvae and eggs, respectively. The results of this calculation show that densities are well distributed among species and that no individual species is dominant within the Project area.

5.2 SPECIAL STATUS SPECIES AND ESSENTIAL FISH HABITAT

No State or Federal listed species were identified in the CalCOFI data; however, there are several species located in the Project area that are managed under NOAA's National Marine Fisheries Service's Pacific Fishery Management Council. The Pacific Fishery Management Council is one of eight regional fishery management councils established by the Magnuson Fishery Conservation and Management Act of 1976 for the purpose of managing fisheries 3-200 miles offshore of the United States of America coastline. The Pacific Council is responsible for fisheries off the coasts of California, Oregon, and Washington.

The groundfish covered by the Council's Groundfish Fishery Management Plan (FMP) include 82 different species that, with a few exceptions, live on or near the bottom of the ocean. The plan covers 64 different species of rockfish, including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch.

Coastal Pelagic Species FMP include northern anchovy, market squid, Pacific bonito, Pacific saury, Pacific herring, Pacific sardine, Pacific (chub or blue) mackerel, and jack (Spanish) mackerel. "Pelagic" means these fish live in the water column as opposed to living near the sea floor. They can generally be found anywhere from the surface to 3,281 feet (1,000 meters/547 fathoms) deep.

Tables 9b and 9d identify the occurrence of special status species potentially impacted by the proposed Project from those found most often to those found least often by larval abundance, and mean egg abundance, respectively. Twelve special status species occur within the source water body. Nine species are identified as having Essential Fish Habitat (EFH) in the region and managed by the Pacific Coast Groundfish

Fisheries Management Plan; seven rockfish species including bocaccio (*Sebastes paucispinis*), Pacific hake (*Merluccius productus)*, and Cabezon (*Scorpaenichthys marmoratus*). Three species managed under the Coastal Pelagic Species FMP include Pacific whiting Pacific mackerel *(Scomber japonicus*), Northern anchovy (*Engraulis mordax*), and Pacific sardine (*Sardinops sagax*).

Based on the CalCOFI data used in this assessment, species managed by the Pacific Fishery Management Council make up approximately 49,713,300 larvae or 0.000013 percent of the total larval density and 214,641,000 eggs or 0.000010 percent of the total egg density estimated to be present in the source water body. Based on the small numbers of these species expected to be entrained in the seawater uptake systems, the impacts on these species would be less than significant.

5.3 RELATIVE MORTALITY

Little reported information currently exists regarding mortality/survivability during ballast entrainment and natural mortality for populations for various species within the region. The Project team based its determination of ichthyoplankton densities for the relative impact assessment of ballast water and other seawater uptakes for impingement and entrainment on the water volume within the established Project source water body quadrat. They used this together with the potential for ichthyoplankton in the Project area to be impacted by entrainment in the FSRU seawater systems. Although 100 percent of the ichthyoplankton potentially impinged or entrained may not experience mortality or serious injury, the Cabrillo Port ichthyoplankton analysis assumed 100 percent mortality. The following summarizes the results of the calculations determining relative mortality for ichthyoplankton occurring within the quadrat.

5.3.1 Determination of Egg and Larval Densities per Water Volume within the Source Water Body

Based on CalCOFI data for the 386 samples at 14 stations located within the quadrat, an average of 3,407 eggs and 607 larvae exists per million gallons of seawater. By using the NOAA method and multiplier of 3, a conservative estimate for eggs and larvae per million gallons of seawater is 10,221 and 1,821, respectively. With extrapolation for the volume of water existing within the quadrat, an average of 21,464,100,000,000 eggs and 3,824,100,000,000 larvae occur within the quadrat.

5.3.2 Relative Egg and Larval Mortalities During FSRU Operations

Based on available information about FSRU operation and ballast water systems during seawater intake operations, based on a weighted average of approximately 4.17 million gallons per day, approximately 14,235 eggs per day (5,195,775 per year) and 2,538 larvae per day (926,370 per year) would be entrained. Adjusting these numbers according to the NOAA method (Thompson 2004), a multiplier of 3 was applied to the calculated ichthyoplankton densities. This resulted in entrainment values of approximately 42,704 eggs per day and 7,614 fish larvae per day.

In addition to the weighted average, the minimum operating condition was also evaluated for comparative purposes. Based on available information about FSRU operation and ballast water systems, during minimum operations 322 days per year (approximately 3.93 million gallons per day), approximately 13,390 eggs per day (4,887,350 per year) and 2,387 larvae per day (871,255 per year) would be entrained. A multiplier of 3 was applied to the calculated ichthyoplankton densities per NOAA (Thompson 2004) to compensate for sampling and gear inefficiencies. This resulted in entrainment values of approximately 40,169 eggs and 7,162 larvae per day.

The maximum operating condition was also evaluated and based on available information about FSRU operation and ballast water systems, during maximum operations four days per year (approximately 16.33 million gallons per day), approximately 55,654 eggs per day (20,313,710 per year) and 9,923 larvae per day (3,621,895 per year) would be entrained. A multiplier of 3 was applied to the calculated ichthyoplankton densities per Thompson (2004) to compensate for sampling and gear inefficiencies. This resulted in entrainment values of approximately 166,963 eggs and 29,768 larvae per day.

Statistical Validity of Data

Figure 5 shows the location of the 14 stations used for the analysis and their relative distributions within the source water body. The 14 CalCOFI sampling stations are dispersed relatively evenly within the source water body quadrat based on the mapped sample location, given the geography of the shelf and the surrounding areas. Therefore, the statistical distribution of data and the validity of the data relative to the source water body are supported, and data obtained from these stations adequately represents the entire quadrat, especially with reference to the location of FSRU.

6.0 CONCLUSIONS

The 4.17 million gallons per day weighted average volume of seawater uptake proposed for the Cabrillo Port Project is significantly lower than cooling water volumes typically used in the cooling systems of LNG and other power generation facilities, both nearshore and offshore. For example, cooling water intake structures used on many nearshore power generating plants in California are designed to withdraw 50 million gallons of seawater per day (California Energy Commission 2004). Some facilities (for example, the Moss Landing Power Plant and Ormond Beach Power Plant) can use between 562 and 864 million gallons (2,127,401 to 3,270,596 m^3) per day (California Energy Commission 2004). Additionally, the present intake volume used in this assessment represents a 60 percent decrease from the intake volume presented in the March 2006 Draft EIR.

Based on the results of the analysis under average operating conditions, the daily mortality for eggs equals 42,704 and represents <0.00000019 percent of the estimated 21,464,100,000,000 eggs found within the quadrat (daily), assuming 100 percent mortality for entrained ichthyoplankton. The daily mortality for larvae equals 7,614 and represents <0.00000019 percent of the estimated 3,824,100,000,000 larvae found within the quadrat. The values presented in the March 2006 Draft EIR indicate daily mortality of 106,296 eggs or 0.00000050 percent of the 21,464,100,000,000 eggs and 18,936 larvae or 0.00000050 percent of the 3,824,100,000,000 larvae found within the quadrat. Comparison of these analyses indicates a 62 percent reduction in egg and larval mortality as a result of design changes and a decrease in seawater intake volume for the FSRU.

The results of this revised analysis confirm that the proposed Project would not have a significant impact on ichthyoplankton. Based on the species present, their densities, and percentages affected by the proposed Project, entrainment impacts on any special status species would be less than significant.

Agencies and research scientists are still not able to quantify potential impacts on ichthyoplankton from entrainment. In a workshop in April 2005, the California Energy Commission Wiser Research Group noted the following shortcomings (among others) in understanding measurement, analysis, and impacts from entrainment:

- If larval losses by entrainment do affect adult populations, it may not be evident, even with multi-decadal surveys; showing significance of an effect is difficult.
- Which are the "best" metrics to use to measure an impact?
- How would you monitor in order to detect effects/impacts?
- Where would you expect impacts to show up (near the facility or much farther away)?
- What do these effects look like over the long term (cumulative effects over time)?

Although no consensus currently exists within the scientific community or responsible agencies regarding what level of impacts on ichthyoplankton are considered significant, the density of ichthyoplankton within the Project area represents typical low-level values expected in offshore areas. The daily mortality values represent impacts on fishery populations which are less than significant when considered relative to densities found within the area potentially impacted by the Project activities.

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Appendix H1.1
Consultations

List of Consultations

Mr. Tom Luster, California Coastal Commission (CCC), March 2005.

Mr. Richard Charter, NOAA Fisheries, via e-mail and telephone, March 2005 through October 2005.

Ms. Joan Lang, USCG, via e-mail and telephone, April - May 2005.

Mr. Ken Kusano, USCG, via e-mail and telephone, April - May 2005.

Mr. Cy Oggins, California State Lands Commission, via e-mail and telephone, April - May 2005.

Ms. Lara A. Ferry-Graham, PhD, Research Faculty & 2004-05 Visiting Scientist, WISER Program Manager, California State Universities Moss Landing Marine Labs, via e-mail and telephone, May 2005.

Mr. Joe O'Hagan, California Energy Commission, via e-mail and telephone, May 2005.

Dr. Pete Raimondi, University of California Santa Cruz, via e-mail and telephone, June 2005.

Dr. Milton Love, UC Santa Barbara, via e-mail September 2006.

Dr. Libe Washburn, UC Santa Barbara, via e-mail September 2006.

Contact Report
BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call (X) Other (X)

Date:	March 2005
Contact Made By:	David Trimm, Fisheries Biologist, E & E
Contact Name:	Mr. Tom Luster
Contact Title:	
Address:	45 Fremont Street, Suite 2000 San Francisco, CA 94105-2219
Phone:	415.904.5248
E-Mail:	tluster@coastal.ca.gov
Copy:	--

Ms. Alison Dettmer (CCC) provided Dave Trimm with Mr. Luster's contact information in order to address the CCC's comments on the Draft EIS/EIR. On March 17, 2005 Dave Trimm provided Mr. Luster with E & E's general approach to the Ichthyoplankton Analysis regarding Comment 24 for review as well as an example of a similar analysis previously conducted for a similar project. Mr. Trimm and Mr. Luster had a conference call on March 22 to discuss further. Mr. Luster did not have any specific comments on the approach.

Per the CCC's comments, after impacts values for ichthyoplankton are developed, avoidance and mitigation strategies may be proposed by the proponent. He would like to have uncertainties discussed in the overall assessment process (ie., stratification information on larvae, etc.), and he would like to see what type of monitoring is proposed to verify that the impact assessment is accurate.

Mr. Luster suggested that Mr. Trimm contact Ms. Sherry McCann (Scripps), who referred him to Mr. Mark Ohman (Scripps), who referred him to Mr. Richard Charter (NOAA). E & E eventually continued consultations with Mr. Charter while collecting the CalCOFI data (see contact report).

Contact Report

BHP Billiton Cabrillo Port LNG

Ecology & Environment, Inc.

Meeting ( )   Telephone Call (X)   Other ( )

Date:	October 19, 2005
Contact Made By:	Adrienne Fink
Contact Name:	Richard Carter
Contact Title:	Research Cruises and Database (NMFS/NOAA)
Address:	CalCOFI
City, State:	La Jolla, California
Phone:	(858) 546-7157
E-Mail:	Richard.Charter@noaa.gov

Details:

I asked Rich to provide some more detailed information on the methods that CalCOFI uses in its research and sampling program in order to be able to more completely address the CCC comments on the ichthyoplankton analysis.

- CalCOFI initially started using bongo tows for sampling back in 1951 because it was the only technology at the time for this type of collection. Currently, there is an alternative method for more stratified sampling; however, in terms of both collection and handling/analysis, this method is cost and time prohibitive for the CalCOFI program.
- Although there might be some spotty information available on species depth stratification, Rich is unaware of any stratified data in time series for the SCB area. There is one paper he recommended that might have some information published by CalCOFI (Moser).
- Since 1978 CalCOFI has been sampling with Manta tows in addition to the bongo tow sampling – (Manta tows are surface waters to 0.18 meters). This data would not be useful to our project as the intake valves are located at a depth of ~43 feet.
- Rich also noted that the scientific data indicates that the 200 meter depth is the limit for most important species and their eggs and larvae. Generally, sampling deeper would not provide additional species information.

Action Items:

- Request the suggested paper by e-mail form another CalCOFI contact. (done 10.19.05af)

Contact Report

BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call (X) Other ( )

Date:	May 2005
Contact Made By:	Adrienne Fink
Contact Name:	Ms. Lara A. Ferry-Graham, PhD
Contact Title:	Research Faculty & 2004-05 Visiting Scientist, WISER Program Manager, California State Universities Moss Landing Marine Labs
Address:	8272 Moss Landing Rd. Moss Landing, CA 95039
Phone:	831-771-4497
E-Mail:	lfgraham@mlml.calstate.edu
Copy:	--

Mr. Joe O'Hagan provided my contact information to Ms. Ferry-Graham and mentioned I was interested in entrainment problems associated with off-shore structures. After learning more about the Project, her immediate thoughts were that the Project will initially have no real issues, stating that the surface waters off-shore are fairly empty. She mentioned that once the Project has been in place awhile, it will attract fish, as all off-shore static structures do.

She suggested I also consult with their Biological Oceanographer, Nick Welschmeyer @ Welschmeyer@mlml.calstate.edu, 831-771-4439. As of September 1, 2005, I have not been able to contact him.

Contact Report

BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call (X) Other (X)

Date:	May 2005
Contact Made By:	Adrienne Fink
Contact Name:	Joe O'Hagan
Contact Title:	California Energy Commission (CEC)
Address:	1516 Ninth Street Sacramento, CA 95814
Phone:	916 653 1651
E-Mail:	Johagan@energy.state.ca.us
Copy:	--

Mr. O' Hagan provided some background information on the current discussions in the industry regarding analyzing impacts and determining significance criteria for ichthyoplankton. He also provided minutes and research topics that were identified during a recent CEC meeting on the topic, a report by Elizabeth Strange on offsite compensation-habitat restoration for once-through cooling impacts including a concise discussion on how entrainment impacts are estimated, and 316(b) reports showing how the entrainment analysis is usually done for power plants in California.

He noted that the CEC is having a paper prepared on the protocol used in this and other 316(b) studies. He stated that none of this will be a great help in establishing an impact threshold for the BHPB Project. The approach has always been to try to estimate what the entrainment means in terms of the adult population for the species analyzed. However, many species are not considered and the value of intervening life stages are also not addressed.

He suggested I contact Mr. Pete Raimondi at UC Santa Cruz @ raimondi@darwin.ucsc.edu, stating that Pete is very knowledgeable in this area and could be very helpful.

Contact Report
BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call (X) Other (X)

Date:	June 27, 2005
Contact Made By:	Adrienne Fink
Contact Name:	Dr. Pete Raimondi
Contact Title:	
Address:	University of California Santa Cruz
Phone:	831-459-5674
E-Mail:	raimondi@darwin.ucsc.edu
Copy:	--

I spoke with Dr. Raimondi via telephone regarding the EMT analysis we developed and the general results of the analysis. Dr. Raimondi has worked with the CCC and other agencies as a scientific advisor on many plankton issues in the past. He stated that he did not think that the project would have impacts based on its location 14 miles offshore and the limited amount of ballast water intake proposed (13 MGD). He noted that the following would go a long way towards addressing agency concerns as he understands them:

1. A discussion of how the CalCOFI data which (he thinks) came from oblique tows (surface to ~200 meters), provides the correct data set for this project and the location of the ballast water uptakes at 43 ft.
2. He noted that ETM is the current state of the art analysis and noted the following items need to be addressed within the analysis:
    a. The validity of the source water body which will include surface water currents and flow;
    b. The % entrainment numbers are meaningful only within the context of the validity of the source water;
    c. Types of species that are present – including special status and managed species.
3. Typically, an ETM analysis will include a separate analysis for each impacted species. Each species would have its own source water identified and analyzed – this provides the proportional impact information per species.

Dr. Raimondi said we could contact him with any additional questions.

Contact Report
BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call (X) Other (X)

Date:	April – May 2005
Contact Made By:	David Trimm, Fisheries Biologist, E & E
Contact Name:	Mr. Richard Charter
Contact Title:	Supervisory Computer Specialist - Data Base Manager
Address:	NOAA 8604 La Jolla Shores Drive La Jolla, California 92037 P.O. Box 271 La Jolla, California
Phone:	(858) 546-7000
E-Mail:	Richard.Charter@noaa.gov
Copy:	--

In order to obtain the information E & E needed to evaluate project impacts on ichthyoplankton, Mr. Charter was provided some specific Project information, including:

1. Lat/long coordinates of polygonal area identified as the potential impact area;
2. Statement of how E & E will evaluate data upon receiving it;
3. Example of bathymetric charts and current flow used to pick the coordinates for the quadrat;
4. Example version of how E & E will use the data for impact assessment; and
5. Spreadsheet of ichthyoplankton data that was provided to E & E by SEAMAP personnel for project in the Gulf of Mexico (for review of what format we need data in).

E & E obtained full data set from Mr. Charter and reviewed content over phone conversation to ensure completeness in May 2005.

Contact Report
BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call ( ) Other (X)

Date: September 22, 2006

Contact Made By: David Trimm, Fisheries Biologist, E & E

Contact Name: Dr. Milton Love

Contact Title:

Address:

Phone: (805) 893-2935

E-Mail: love@lifesci.uscb.edu

D. Trimm contacted Dr. Milton Love by email concerning the areas that need to be considered around the Cabrillo Port for assessing ichthyoplankton impacts. D. Trimm explained our previous approach and explained that we were trying to determine the appropriate CalCOFI stations that should be used for determining accurate impacts of entrainment for the proposed site. Dr. Love agreed that our approach for determining the potential current transport was appropriate. He could not suggest exactly which sample locations would be most appropriate or how big the quadrat should be, but he referred D. Trimm to Dr. Libe Washburn (UC Santa Barbara) for information on spawning studies in the area near the terminal. Dr. Love also referred D. Trimm to Steve Ralston of NMFS (Santa Cruz) for similar information.

Contact Report

BHP Billiton Cabrillo Port LNG

Ecology and Environment, Inc.

Meeting ( ) Telephone Call ( ) Other (X)

Date: September 22, 2006

Contact Made By: David Trimm, Fisheries Biologist, E & E

Contact Name: Dr. Libe Washburn

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D. Trimm contacted Dr. Washburn and to ask for his input concerning the areas that need to be considered around the Cabrillo Port for assessing ichthyoplankton impacts.

D. Trimm emailed Dr. Libe Washburn to ask about surface current transport of larvae near the Cabrillo Port site. Dr. Washburn responded by suggesting that a current meter (ANMI) deployed by Scripps near Anacapa Island had data from 1992 to 2004. E & E accessed the Scripps site (http://www-ccs.ucsd.edu/ccs/about_datazoo.html) and retrieved data for the ANMI mooring near Anacapa Island, which included complete current and depth data for the year 1992-1993 at depths of 5, 45, and 100 meters.

Plotting of this data confirmed that surface current trajectories were provided at the meter location, but could not be used to determine how far from the Cabrillo Port site currents could potentially be considered as affecting larval transport to the facility. It appears that there may be hydrologic modeling ongoing in the Southern California Bight area that could provide insight regarding currents and patterns for future surveys or the development of a monitoring program.

Appendix H1.2
Tables

Table 2a. Seawater Intake Scenarios for Impact Analysis						
Source	**Total Volume in Gallons (provided by BHPB)**	**Uptake Rate**	**Frequency**	**Average Total Volume (MGD)**	**Average Total Volume (MGW)**	**Total Volume (MGY)**
Scenario 1 - Ballast Water operating at 800 MMscfd	163,750 /hour	2,729 gpm	322 days per year	3.93	27.51	1,265.46
Scenario 3 – Ballast Water and IGG operating at 1200 MMscfd	680,625 /event	11,343 gpm	4 days per year	16.33	NA	65.32
Weighted Average of Scenarios 1 and 3 (3.93 MGD and 16.33 MGD)	173,750 /hour	2,895 gpm	326 days per year	4.17	29.19	1,359.42

Table 2b. Additional (Negligible) Seawater Uptakes

Source	Total Volume in Gallons (provided by BHPB)	Uptake Rate	Time Period	Frequency	Average Total Volume (MGD)	Average Total Volume (MGW)	Total Volume (MGY)
Fire Pump Testing	85,854 /event	5,723 gpm	15 minutes	once/week	0.01	0.08	4.12
Main Fire System Test	105,700 /year	unknown	unknown	once/year	0.00	0.00	0.11
TOTALS					**0.01**	**0.08**	**4.23**

Source: WorleyParsons, 2006.

Notes: MGD = million gallons per day; MGW = million gallons per week; MGY = million gallons per year.

Results have been rounded to reflect the appropriate level of scientific accuracy. Negligible differences in volume totals may result due to rounding with additional calculation.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Bathylagus ochotensis	popeye blacksmelt	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		75-400 m
Bathylagus wesethi	Snubnose blacksmelt	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		75-250 m with high concentrations at 150-175 m. At other stations they ranged from 50-125 m, with high concentrations at 75-100 m.
Ceratoscopelus townsendi	dogtooth lampfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		upper 175 m with peak at 25-50 m.
Chauliodus macouni	Pacific viperfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		wide distributions, no captures in the 100-200 m strata.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Citharichthys sordidus	Pacific sanddab	Bodega Bay, CA[5]	0-20 m, 20-40 m, 40-60 m, 60-90 m, 90-140 m.	shallower depths at night than during the day. Largest catches were made at night.	most abundant at 60-90 m during the day, 90-140 m crepuscular, 40-60 m at night. Migrate through the pycnocline.
Citharichthys spp.	sanddabs	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	inshore only, limited to upper 50 m.
Citharichthys stigmaeus	speckled sanddab	Bodega Bay, CA[5]	0-20 m, 20-40 m, 40-60 m, 60-90 m, 90-140 m.	shallower at night than during the day	0-60 m
Diogenichthys atlanticus	longfin lanternfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		50-300 m
Engraulis mordax	Northern anchovy	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		peak concentration at 25-50m.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Engraulis mordax	Northern anchovy	San Onofre Nuclear Generating Station, CA[4]	neuston (upper 14cm of water column), the entire midwater (0.5 m below the surface to 1.0 m above the bottom), and epibenthic (bottom).	vertical distributions appear to be related to feeding mode, life history, and availability of food.	A range of size classes were found at all depths. High densities in neuston during spawning, even distributions other times.
Engraulis mordax	Northern anchovy	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	90-95% of eggs and larvae in upper 30 m. Average egg density at the surface was more than double that in the 0-10 m stratum.
Genyonemus lineatus	white croaker	San Onofre Nuclear Generating Station, CA[4]	neuston (upper 14cm of water column), the entire midwater (0.5 m below the surface to 1.0 m above the bottom), and epibenthic (bottom).	vertical distributions appear to be related to feeding mode, life history, and availability of food.	Vertical distributions varied throughout the year depending on spawning. A range of size classes were found at all depths. Relatively low numbers in the neuston, most larvae found in epibenthic samples October-June.
Genyonemus lineatus	white croaker	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae typically occurred in the upper 20-30 m.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Hygophum atratum (or H. reinhardtii)	Reinhardt's lantern fish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		not present in samples
Lestidiops ringens	Slender barracudina	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		peak concentrations at 50-75 m and 175-200 m.
Leuroglossus stilbius	California smoothtongue	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		200-300 m
Leuroglossus stilbius	California smoothtongue	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae typically occurred in high densities in most strata down to 200 m. However, larvae were absent from the 0-40 m stratum offshore.
Melamphaes spp.	bigscale species	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		peaks at 75-100 m. and 150-175 m.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Merluccius productus	Pacific hake	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		not present in samples
Merluccius productus	Pacific hake	Southern and Central California, Southern California Bight[3]	0-25 m, 25-50 m, 50-75 m, 75-100 m, 100-125 m, 125-150 m, 150-200 m, 200-250 m, 250-300 m.		all strata down to 250 m, most eggs between 50-100 m, early stages between 75-150 m, late stages 50-100 m.
Merluccius productus	Pacific hake	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae typically occurred in the upper 80m, although some distribution down to 120 m.
Microstoma microstoma	slender argentine	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		200-225 m and deeper.
Paralichthys califonicus	California halibut	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	Did not occur in offshore samples. Limited to upper 30 m inshore.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Peprilus simillimus	Pacific pompano	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae only occurred in the upper 30-40 m.
Protomyctophum crockeri (P. oodie)	California flaglightfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		175-550 m with peaks at 200-225 m. Other stations observed 225-550 m with peaks at 300-400 m.
Scomber japonicus	chub mackerel	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		upper 100 m, highest concentrations 25-50 m.
Sebastes jordani	shortbelly rockfish	Bodega Bay, CA[5]	0-20 m, 20-40 m, 40-60 m, 60-90 m, 90-140 m.		most abundant at both 20-40 m and 60-90 m during the day, 20-40 m crepuscular, 40-60 m at night
Sebastes spp.	rockfish species	Bodega Bay, CA[5]	0-20 m, 20-40 m, 40-60 m, 60-90 m, 90-140 m.	most abundant in upper mixed layers	generally found above the pycnocline, but highly variable.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Sebastes spp.	rockfish species	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		75-150 m
Sebastes spp.	rockfish species	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae typically occurred in the upper 80 m. Highest densities were in the 40-80 m stratum offshore, with extremely low densities in the upper 30 m.
Seriphus politus	queenfish	San Onofre Nuclear Generating Station, CA[4]	neuston (upper 14cm of water column), the entire midwater (0.5 m below the surface to 1.0 m above the bottom), and epibenthic (bottom).	vertical distributions appear to be related to feeding mode, life history, and availability of food.	A range of size classes were found at all depths. Significant numbers found in neuston in March and April. Midwater samples showed significant numbers in March through September. Majority of larvae were found in epibenthic samples.
Seriphus politus	queenfish	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	occurred only at inshore stations sampled. Limited to upper 10 m.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Stenobrachius leucopsarus	northern lampfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		75-200 m
Stenobrachius leucopsarus	northern lampfish	Southern California[2]	0-10 m, 10-20 m, 20-30 m, 30-40 m, 40-50 m. 0-40 m, 40-80 m, 80-120 m, 120-160 m, 160-200 m.	average total plankton volumes (includes all species in study) increased markedly in the 40-80 m stratum.	larvae typically occurred in the upper 200 m. Greatest densities between 40-80 m. Average densities were greater inshore than offshore.
Symbolophorus californicus	Bigfin lanternfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		25-300 m.
Tarletonbeania crenularis	blue lanternfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		70-400 m, with peak concentration between 75-150 m.

Table 5 Summary of Vertical Distributions for Species Occurring in the Southern California Bight

Scientific Name	Common Name	Study/Sample Location	Stratum Sampled in Study	Vertical Migration Patterns	Depth Species Found (meters)
Trachurus symmetricus	jack mackerel	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		restricted to upper 100 m, peak at 25-50 m.
Vinciguerrua lucetia	Panama lightfish	Ensenada Front, 32 degrees north latitude, California[1]	16 depth strata: 1,000-850 m, 700-550 m, 550-400 m, 400-300 m, 300-250 m, 250-225 m, 225-200 m, 200-175 m, 175-150 m, 150-125 m, 125-100 m, 100-75 m, 75-50 m, 50-25 m, 25-0 m.		upper 150 m with peak concentration at 50-75 m.

References:

[1]Moser, H.G, Smith, P. E. 1983. Larval Fish Assemblages of the California Current Region and Their Horizontal and Vertical Distributions Across a Front. Bulletin of Marine Science, 53(2): 645-691.

[2]Moser, H. G., Pommeranz, T. 1999. Vertical Distribution of eggs and larvae of northern anchovy, *Engraulis mordax*, and of the larvae of associated Fishes at Two Sites in the Southern California Bight. Fish Bulletin 97(4).

[3]Moser, H. G., Lo, Nancy C. H., Smith, P. E. 1997. Vertical Distribution of Pacific Hake Eggs in Relation to Stage of Development and Temperature. CalCOFI Rep., Volume 38.

[4]Schlotterbeck, R.E. and D.W. Connally. 1982. Vertical Stratification of three Nearshore Southern California Larval Fishes (*Engaulis mordax*, *Genyonemus lineatus*, and *Seriphus politus*). Fishery Bulletin: Volume 80, No. 4.

[5]Sakuma, Keith M., Ralston, S., Roberts, D. A. 1999. Diel Vertical Distribution of Postflexion Larval *Citharichthys* spp. and *Sebastes* Spp. Off Central California. Fisheries Oceanography. 8:1, 68-76.

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200001	83.3	42	34.1767	-119.5067
200001	83.3	51	33.8767	-120.1367
200001	83.3	55	33.745	-120.4183
200001	86.7	33	33.8883	-118.49
200001	86.7	35	33.8233	-118.6283
200001	86.7	40	33.6583	-118.9767
200001	86.7	45	33.49	-119.3183
200001	86.7	50	33.3233	-119.6583
200001	86.7	55	33.155	-120.0067
200001	90	30	33.415	-117.9067
200001	90	35	33.25	-118.2517
200001	90	37	33.1867	-118.3883
200001	90	45	32.915	-118.9317
200001	90	53	32.65	-119.4817
200001	93.3	26.7	32.955	-117.305
200001	93.3	35	32.68	-117.8733
200001	93.3	40	32.5133	-118.21
200001	93.3	45	32.3417	-118.555
200001	93.3	50	32.18	-118.89
200001	93.3	55	32.0067	-119.235
200004	83.3	40.6	34.225	-119.4117
200004	83.3	42	34.1783	-119.5083
200004	83.3	51	33.8767	-120.135
200004	83.3	55	33.745	-120.41
200004	86.7	33	33.89	-118.49
200004	86.7	35	33.825	-118.6333
200004	86.7	40	33.6567	-118.9767
200004	86.7	45	33.4933	-119.3217
200004	86.7	50	33.3233	-119.6633
200004	86.7	55	33.1583	-120.0067
200004	90	28	33.485	-117.7683
200004	90	30	33.4167	-117.9083
200004	90	35	33.2483	-118.2517
200004	90	37	33.185	-118.3867
200004	90	45	32.9183	-118.9383

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200004	90	53	32.6517	-119.4817
200004	93.3	26.7	32.9567	-117.305
200004	93.3	28	32.9133	-117.395
200004	93.3	30	32.8467	-117.5317
200004	93.3	35	32.6817	-117.8733
200004	93.3	40	32.515	-118.21
200004	93.3	45	32.3483	-118.5517
200004	93.3	50	32.1817	-118.8883
200004	93.3	55	32.0133	-119.2333
200007	83.3	40.6	34.225	-119.4117
200007	83.3	42	34.1767	-119.5083
200007	83.3	51	33.8783	-120.1333
200007	83.3	55	33.745	-120.41
200007	86.7	33	33.89	-118.49
200007	86.7	35	33.8233	-118.6283
200007	93.3	26.7	32.955	-117.305
200007	93.3	30	32.8467	-117.53
200007	93.3	35	32.68	-117.8733
200007	93.3	40	32.5133	-118.2117
200007	93.3	45	32.3467	-118.5533
200007	93.3	50	32.185	-118.8833
200007	93.3	55	32.0133	-119.2333
200010	83.3	40.6	34.225	-119.4133
200010	83.3	42	34.1783	-119.5117
200010	83.3	51	33.8783	-120.135
200010	83.3	55	33.745	-120.415
200010	86.7	33	33.8883	-118.4933
200010	86.7	35	33.825	-118.6317
200010	86.7	40	33.655	-118.9767
200010	86.7	45	33.4933	-119.3167
200010	86.7	50	33.315	-119.6617
200010	86.7	55	33.1583	-120.0067
200010	90	28	33.4833	-117.7683
200010	90	30	33.4183	-117.905
200010	90	35	33.2517	-118.25
200010	90	45	32.91	-118.9167

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200010	90	53	32.6533	-119.4833
200010	93.3	26.7	32.9567	-117.305
200010	93.3	28	32.9133	-117.395
200010	93.3	30	32.8467	-117.5317
200010	93.3	35	32.6867	-117.875
200010	93.3	45	32.345	-118.555
200010	93.3	50	32.18	-118.8933
200010	93.3	55	32.01	-119.2333
200101	83.3	40.6	34.225	-119.415
200101	83.3	42	34.175	-119.515
200101	83.3	51	33.8783	-120.135
200101	83.3	55	33.745	-120.41
200101	86.7	33	33.8883	-118.49
200101	86.7	35	33.8233	-118.6283
200101	86.7	40	33.6567	-118.9767
200101	86.7	45	33.49	-119.3183
200101	86.7	50	33.3233	-119.6633
200101	86.7	55	33.1517	-119.9983
200101	90	28	33.485	-117.7683
200101	90	30	33.4183	-117.905
200101	90	35	33.2517	-118.2483
200101	90	37	33.185	-118.3867
200101	90	45	32.92	-118.935
200101	90	53	32.65	-119.4817
200101	93.3	26.7	32.9567	-117.305
200101	93.3	30	32.85	-117.53
200101	93.3	35	32.68	-117.8733
200101	93.3	40	32.5133	-118.2133
200101	93.3	45	32.35	-118.5533
200101	93.3	50	32.1767	-118.8917
200104	83.3	42	34.1783	-119.5067
200104	83.3	51	33.88	-120.1367
200104	83.3	55	33.745	-120.41
200104	86.7	33	33.89	-118.4883
200104	86.7	35	33.825	-118.6267
200104	86.7	40	33.6567	-118.975

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200104	86.7	45	33.49	-119.315
200104	86.7	50	33.3217	-119.6617
200104	86.7	55	33.1583	-120.0033
200104	90	28	33.485	-117.77
200104	90	30	33.4183	-117.9067
200104	90	35	33.2517	-118.2533
200104	90	37	33.185	-118.3883
200104	90	45	32.9183	-118.9367
200104	90	53	32.6533	-119.48
200104	93.3	26.7	32.955	-117.305
200104	93.3	28	32.9117	-117.395
200104	93.3	30	32.8467	-117.5317
200104	93.3	35	32.6817	-117.875
200104	93.3	40	32.515	-118.215
200104	93.3	45	32.3483	-118.5567
200104	93.3	50	32.1783	-118.8933
200104	93.3	55	32.015	-119.23
200107	83.3	40.6	34.2267	-119.41
200107	83.3	42	34.1783	-119.5083
200107	83.3	51	33.88	-120.1383
200107	83.3	55	33.7467	-120.41
200107	86.7	33	33.8883	-118.49
200107	86.7	35	33.8267	-118.6267
200107	86.7	40	33.6567	-118.975
200107	86.7	45	33.49	-119.3183
200107	86.7	50	33.3233	-119.665
200107	86.7	55	33.1533	-120.0083
200107	90	28	33.4833	-117.77
200107	90	30	33.4283	-117.905
200107	90	35	33.2533	-118.255
200107	90	37	33.185	-118.3883
200107	90	45	32.92	-118.9333
200107	90	53	32.65	-119.4817
200107	93.3	26.7	32.9567	-117.305
200107	93.3	28	32.9133	-117.3933
200107	93.3	30	32.8467	-117.5317

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200107	93.3	35	32.68	-117.8733
200107	93.3	40	32.515	-118.21
200107	93.3	50	32.1817	-118.89
200107	93.3	55	32.0183	-119.2317
200110	83.3	40.6	34.2217	-119.4117
200110	83.3	42	34.175	-119.5033
200110	83.3	51	33.8783	-120.135
200110	83.3	55	33.7417	-120.41
200110	86.7	33	33.8867	-118.4833
200110	86.7	35	33.8217	-118.625
200110	86.7	40	33.6667	-118.97
200110	86.7	45	33.4933	-119.3133
200110	86.7	50	33.3283	-119.6567
200110	86.7	55	33.16	-119.9983
200110	90	28	33.48	-117.7633
200110	90	30	33.4167	-117.9083
200110	90	35	33.2517	-118.25
200110	90	37	33.185	-118.3867
200110	90	45	32.9183	-118.935
200110	90	53	32.6483	-119.4933
200110	93.3	26.7	32.9567	-117.305
200110	93.3	28	32.9133	-117.395
200110	93.3	30	32.8467	-117.5317
200110	93.3	35	32.68	-117.8733
200110	93.3	40	32.5133	-118.2133
200110	93.3	45	32.3517	-118.5567
200110	93.3	50	32.1817	-118.885
200110	93.3	55	32.0133	-119.2333
200201	83.3	40.6	34.2267	-119.4117
200201	83.3	42	34.175	-119.5133
200201	83.3	51	33.875	-120.1317
200201	83.3	55	33.7467	-120.4117
200201	86.7	33	33.8867	-118.4883
200201	86.7	35	33.8217	-118.6283
200201	86.7	40	33.6617	-118.975
200201	86.7	45	33.4917	-119.3167

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200201	86.7	50	33.3267	-119.6617
200201	86.7	55	33.1567	-120.015
200201	90	30	33.42	-117.905
200201	90	35	33.2533	-118.25
200201	90	37	33.185	-118.3867
200201	90	45	32.9183	-118.935
200201	90	53	32.6517	-119.4817
200201	93.3	26.7	32.9583	-117.3033
200201	93.3	28	32.915	-117.3933
200201	93.3	30	32.8483	-117.5317
200201	93.3	35	32.6783	-117.87
200201	93.3	40	32.5133	-118.2133
200201	93.3	45	32.3517	-118.5533
200201	93.3	50	32.1783	-118.8933
200201	93.3	55	32.0133	-119.2317
200204	83.3	40.6	34.2267	-119.415
200204	83.3	42	34.175	-119.5083
200204	83.3	51	33.8783	-120.135
200204	83.3	55	33.7417	-120.41
200204	86.7	33	33.8883	-118.49
200204	86.7	35	33.8267	-118.6217
200204	86.7	40	33.66	-118.9733
200204	86.7	45	33.4917	-119.3183
200204	86.7	50	33.325	-119.6583
200204	86.7	55	33.1567	-120.0067
200204	90	28	33.4833	-117.7717
200204	90	30	33.4217	-117.905
200204	90	35	33.2483	-118.2517
200204	90	37	33.1833	-118.39
200204	90	45	32.9183	-118.935
200204	90	53	32.6533	-119.4867
200204	93.3	26.7	32.955	-117.305
200204	93.3	28	32.9133	-117.395
200204	93.3	30	32.8483	-117.53
200204	93.3	35	32.68	-117.8733
200204	93.3	40	32.515	-118.215

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200204	93.3	45	32.3467	-118.555
200204	93.3	50	32.18	-118.89
200204	93.3	55	32.0133	-119.2317
200207	83.3	42	34.1783	-119.5083
200207	83.3	51	33.8783	-120.1333
200207	83.3	55	33.7467	-120.4133
200207	86.7	33	33.885	-118.49
200207	86.7	35	33.8233	-118.63
200207	86.7	40	33.6567	-118.9767
200207	86.7	50	33.3233	-119.6633
200207	90	28	33.485	-117.7717
200207	90	30	33.4183	-117.905
200207	90	35	33.2517	-118.25
200207	90	37	33.185	-118.385
200207	90	45	32.9183	-118.9367
200207	90	53	32.6517	-119.4817
200207	93.3	26.7	32.9567	-117.3083
200207	93.3	28	32.9117	-117.395
200207	93.3	30	32.8433	-117.5317
200207	93.3	35	32.68	-117.875
200207	93.3	40	32.515	-118.2133
200207	93.3	45	32.3467	-118.5533
200207	93.3	50	32.18	-118.8917
200207	93.3	55	32.0133	-119.2333
200211	83.3	40.6	34.2233	-119.41
200211	83.3	42	34.185	-119.525
200211	83.3	51	33.88	-120.1367
200211	86.7	33	33.8783	-118.4917
200211	86.7	35	33.825	-118.625
200211	86.7	45	33.49	-119.3133
200211	86.7	50	33.3217	-119.6683
200211	90	28	33.485	-117.77
200211	90	30	33.425	-117.9117
200211	90	35	33.2533	-118.25
200211	90	37	33.1867	-118.39
200211	90	45	32.9183	-118.94

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200211	90	53	32.655	-119.48
200211	93.3	30	32.8467	-117.535
200211	93.3	35	32.6833	-117.8683
200211	93.3	40	32.5117	-118.215
200211	93.3	50	32.18	-118.895
200211	93.3	55	32.0117	-119.2267
200302	83.3	40.6	34.225	-119.4117
200302	83.3	42	34.1783	-119.5083
200302	83.3	51	33.8783	-120.135
200302	83.3	55	33.7433	-120.4117
200302	86.7	33	33.8883	-118.49
200302	86.7	35	33.8233	-118.63
200302	86.7	40	33.6567	-118.975
200302	86.7	45	33.49	-119.3183
200302	86.7	50	33.325	-119.6617
200302	86.7	55	33.1567	-120.005
200302	90	28	33.485	-117.7683
200302	90	30	33.4183	-117.905
200302	90	35	33.2517	-118.25
200302	90	37	33.1867	-118.3867
200302	90	45	32.9183	-118.9367
200302	90	53	32.6517	-119.48
200302	93.3	26.7	32.96	-117.305
200302	93.3	28	32.9133	-117.395
200302	93.3	30	32.8483	-117.53
200302	93.3	35	32.68	-117.8733
200302	93.3	40	32.5133	-118.2133
200302	93.3	45	32.3467	-118.5517
200302	93.3	50	32.1817	-118.8917
200302	93.3	55	32.0133	-119.2333
200304	83.3	42	34.1783	-119.5083
200304	83.3	51	33.8783	-120.1333
200304	83.3	55	33.745	-120.41
200304	86.7	33	33.8917	-118.49
200304	86.7	35	33.8233	-118.6233
200304	86.7	40	33.6567	-118.9733

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200304	86.7	45	33.49	-119.3183
200304	86.7	50	33.3233	-119.6633
200304	86.7	55	33.1533	-120.005
200304	90	28	33.485	-117.7683
200304	90	30	33.4183	-117.905
200304	90	35	33.2517	-118.25
200304	90	37	33.185	-118.3867
200304	90	45	32.9183	-118.935
200304	90	53	32.6517	-119.4817
200304	93.3	26.7	32.9567	-117.305
200304	93.3	28	32.9133	-117.395
200304	93.3	30	32.8467	-117.5317
200304	93.3	35	32.68	-117.8717
200304	93.3	40	32.5133	-118.2133
200304	93.3	45	32.3433	-118.5733
200304	93.3	50	32.18	-118.8933
200304	93.3	55	32.0133	-119.2333
200307	83.3	42	34.1767	-119.5083
200307	86.7	33	33.8917	-118.49
200307	86.7	35	33.8233	-118.63
200307	86.7	45	33.4917	-119.3183
200307	86.7	55	33.155	-120.015
200307	90	28	33.485	-117.7683
200307	90	35	33.2517	-118.2483
200307	90	53	32.6533	-119.4817
200307	93.3	26.7	32.9567	-117.3067
200307	93.3	28	32.9117	-117.3967
200307	93.3	28	32.9117	-117.3967
200307	93.3	30	32.8467	-117.5333
200307	93.3	35	32.6767	-117.8733
200307	93.3	40	32.515	-118.2133
200307	93.3	45	32.3467	-118.555
200307	93.3	50	32.1783	-118.8933
200310	83.3	42	34.1783	-119.51
200310	83.3	55	33.745	-120.4133
200310	86.7	33	33.8867	-118.49

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200310	86.7	35	33.825	-118.6267
200310	86.7	40	33.6583	-118.9733
200310	86.7	45	33.4917	-119.32
200310	86.7	55	33.16	-120.0033
200310	90	28	33.485	-117.7683
200310	90	30	33.4167	-117.9033
200310	90	35	33.2517	-118.25
200310	90	37	33.185	-118.3883
200310	90	45	32.9183	-118.9367
200310	90	53	32.6533	-119.485
200310	93.3	26.7	32.9567	-117.3067
200310	93.3	28	32.9133	-117.3883
200310	93.3	30	32.845	-117.5333
200310	93.3	35	32.6783	-117.8767
200310	93.3	40	32.515	-118.2117
200310	93.3	45	32.3517	-118.55
200310	93.3	55	32.0117	-119.2333
200401	83.3	42	34.1817	-119.51
200401	83.3	51	33.88	-120.135
200401	83.3	55	33.7433	-120.4067
200401	86.7	33	33.8883	-118.4917
200401	86.7	35	33.8217	-118.6283
200401	86.7	40	33.6567	-118.975
200401	86.7	45	33.4917	-119.32
200401	86.7	50	33.325	-119.6633
200401	86.7	55	33.155	-120.0067
200401	90	28	33.4833	-117.7683
200401	90	30	33.415	-117.9067
200401	90	35	33.2533	-118.2483
200401	90	37	33.185	-118.385
200401	90	45	32.9183	-118.9367
200401	90	53	32.6517	-119.4817
200401	93.3	26.7	32.915	-117.3033
200401	93.3	28	32.9167	-117.3967
200401	93.3	30	32.8467	-117.53
200401	93.3	35	32.6817	-117.8717

Table 6a. CalCOFI Samples Collected by Station Within Established Quadrat Near Cabrillo Port

Cruise Number	CalCOFI Line	CalCOFI Station	Latitude	Longitude
200401	93.3	45	32.3483	-118.5533
200401	93.3	55	32.0133	-119.235
200404	83.3	40.6	34.225	-119.4133
200404	83.3	42	34.1817	-119.5083
200404	83.3	51	33.8783	-120.1383
200404	83.3	55	33.745	-120.41
200404	86.7	33	33.89	-118.4883
200404	86.7	35	33.8233	-118.6283
200404	86.7	40	33.6567	-118.975
200404	86.7	45	33.4883	-119.3167
200404	86.7	50	33.3233	-119.66
200404	86.7	55	33.1533	-120.0033
200404	90	28	33.485	-117.7683
200404	90	30	33.4183	-117.905
200404	90	35	33.2517	-118.255
200404	90	37	33.185	-118.3867
200404	90	45	32.9183	-118.935
200404	90	53	32.6533	-119.4817
200404	93.3	26.7	32.9567	-117.305
200404	93.3	28	32.9133	-117.3933
200404	93.3	30	32.8467	-117.5317
200404	93.3	35	32.68	-117.8733
200404	93.3	40	32.515	-118.2133
200404	93.3	45	32.3467	-118.5533
200404	93.3	50	32.1817	-118.8983
200404	93.3	55	32.0133	-119.2333

Table 6b. CalCOFI Stations

CalCOFI Station	CalCOFI_Line	Latitude	Longitude
55	83.3	33.745	-120.4183
53	90	32.65	-119.4817
51	83.3	33.8767	-120.1367
45	86.7	33.49	-119.3183
45	93.3	32.3467	-118.5533
42	83.3	34.1767	-119.5067
40.6	83.3	34.225	-119.4117
40	86.7	33.6583	-118.9767
37	90	33.1867	-118.3883
35	86.7	33.8233	-118.6283
33	86.7	33.8883	-118.49
30	90	33.415	-117.9067
28	90	33.485	-117.7683
26.7	93.3	32.955	-117.305

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
26.7	200004	93.3	20000407	32.9567	-117.305	3.743	0.24581
26.7	200101	93.3	20010107	32.9567	-117.305	0	0.06166
26.7	200001	93.3	20000107	32.955	-117.305	0	0.02462
26.7	200010	93.3	20001012	32.9567	-117.305	0.067	0.09734
26.7	200302	93.3	20030130	32.96	-117.305	0.002	0.00837
26.7	200201	93.3	20020124	32.9583	-117.3033	0.057	0.06457
26.7	200110	93.3	20011025	32.9567	-117.305	0.08	0.04437
26.7	200007	93.3	20000629	32.955	-117.305	1.746	0.06589
26.7	200204	93.3	20020328	32.955	-117.305	0.165	0.48209
26.7	200401	93.3	20040105	32.915	-117.3033	0.147	0.05656
26.7	200107	93.3	20010710	32.9567	-117.305	0.152	0.08591
26.7	200207	93.3	20020702	32.9567	-117.3083	0.402	0.0066
26.7	200310	93.3	20031020	32.9567	-117.3067	0.017	0.02573
26.7	200104	93.3	20010406	32.955	-117.305	0.229	0.18182
26.7	200307	93.3	20030717	32.9567	-117.3067	0.622	0.09778
26.7	200404	93.3	20040323	32.9567	-117.305	0.695	0.01986
26.7	200304	93.3	20030404	32.9567	-117.305	0.954	0.13573
28	200307	90	20030722	33.485	-117.7683	0.525	0.08394
28	200207	93.3	20020702	32.9117	-117.395	0.027	0.00994
28	200004	90	20000413	33.485	-117.7683	1.075	0.10903
28	200204	90	20020403	33.4833	-117.7717	0.488	0.15702
28	200004	93.3	20000407	32.9133	-117.395	0.282	0.14359
28	200304	93.3	20030404	32.9133	-117.395	0.253	0.06508

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
28	200110	90	20011031	33.48	-117.7633	0.085	0.03419
28	200010	90	20001019	33.4833	-117.7683	0.843	0.04013
28	200304	90	20030410	33.485	-117.7683	4.674	0.05973
28	200310	93.3	20031020	32.9133	-117.3883	0.005	0.02999
28	200201	93.3	20020124	32.915	-117.3933	0.224	0.02714
28	200207	90	20020708	33.485	-117.7717	0.787	0.0138
28	200310	90	20031026	33.485	-117.7683	0.08	0.00348
28	200010	93.3	20001012	32.9133	-117.395	0.005	0.00248
28	200307	93.3	20030717	32.9117	-117.3967	0.006	0.00426
28	200307	93.3	20030717	32.9117	-117.3967	0.006	0.00426
28	200204	93.3	20020328	32.9133	-117.395	0.108	0.07083
28	200110	93.3	20011025	32.9133	-117.395	0.016	0.00226
28	200404	93.3	20040323	32.9133	-117.3933	0.204	0.05489
28	200401	90	20040111	33.4833	-117.7683	0.25	0.01
28	200404	90	20040329	33.485	-117.7683	0.386	0.05356
28	200302	93.3	20030130	32.9133	-117.395	0	0.03472
28	200104	93.3	20010406	32.9117	-117.395	0.055	0.20706
28	200302	90	20030205	33.485	-117.7683	0.013	0.03024
28	200107	90	20010717	33.4833	-117.77	1.018	0.03337
28	200211	90	20021116	33.485	-117.77	0.007	0.00651
28	200107	93.3	20010710	32.9133	-117.3933	0.029	0.17737
28	200401	93.3	20040105	32.9167	-117.3967	0.161	0.0299
28	200101	90	20010114	33.485	-117.7683	0.446	0.01623
28	200104	90	20010413	33.485	-117.77	6.593	0.21865

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
30	200204	93.3	20020328	32.8483	-117.53	0.165	0.16964
30	200204	90	20020403	33.4217	-117.905	0.305	0.15992
30	200104	93.3	20010406	32.8467	-117.5317	0.083	0.09624
30	200211	93.3	20021110	32.8467	-117.535	0	0.0044
30	200201	93.3	20020124	32.8483	-117.5317	0.136	0.04954
30	200404	90	20040329	33.4183	-117.905	0.247	0.13577
30	200307	93.3	20030717	32.8467	-117.5333	0.004	0.00447
30	200004	90	20000413	33.4167	-117.9083	0.223	0.28933
30	200211	90	20021116	33.425	-117.9117	0.002	0.19603
30	200304	90	20030410	33.4183	-117.905	0.419	0.02731
30	200007	93.3	20000629	32.8467	-117.53	0.005	0.01349
30	200404	93.3	20040323	32.8467	-117.5317	0.194	0.08889
30	200010	90	20001019	33.4183	-117.905	0.127	0.01358
30	200104	90	20010413	33.4183	-117.9067	4.73	0.69584
30	200304	93.3	20030404	32.8467	-117.5317	0.185	0.58679
30	200310	93.3	20031020	32.845	-117.5333	0	0.02277
30	200401	90	20040111	33.415	-117.9067	0.083	0.01385
30	200207	93.3	20020702	32.8433	-117.5317	0.036	0.00241
30	200107	93.3	20010710	32.8467	-117.5317	0.014	0.06349
30	200201	90	20020130	33.42	-117.905	0.181	0.23083
30	200401	93.3	20040106	32.8467	-117.53	0.043	0.01443
30	200110	90	20011031	33.4167	-117.9083	0.004	0.00443
30	200207	90	20020708	33.4183	-117.905	0.028	0.00504
30	200302	93.3	20030130	32.8483	-117.53	0.012	0.0712

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
30	200110	93.3	20011025	32.8467	-117.5317	0.14	0.02298
30	200302	90	20030205	33.4183	-117.905	0.011	0.0196
30	200101	90	20010114	33.4183	-117.905	0.01	0.00985
30	200010	93.3	20001012	32.8467	-117.5317	0	0.00909
30	200310	90	20031026	33.4167	-117.9033	0	0.07878
30	200001	90	20000114	33.415	-117.9067	0.101	0.0944
30	200101	93.3	20010108	32.85	-117.53	0.005	0.00466
30	200004	93.3	20000407	32.8467	-117.5317	0.042	0.50331
30	200107	90	20010717	33.4283	-117.905	0.025	0.09422
33	200211	86.7	20021116	33.8783	-118.4917	0.147	0.09958
33	200304	86.7	20030410	33.8917	-118.49	1.271	0.14733
33	200207	86.7	20020708	33.885	-118.49	0.711	0.01031
33	200010	86.7	20001019	33.8883	-118.4933	0.579	0.27921
33	200302	86.7	20030206	33.8883	-118.49	2.634	0.4418
33	200007	86.7	20000705	33.89	-118.49	0.193	0.03513
33	200101	86.7	20010114	33.8883	-118.49	4.426	0.14692
33	200404	86.7	20040329	33.89	-118.4883	0.323	0.03404
33	200401	86.7	20040112	33.8883	-118.4917	0.806	0.05038
33	200110	86.7	20011031	33.8867	-118.4833	13.49	0.28634
33	200107	86.7	20010717	33.8883	-118.49	1.676	0.0463
33	200310	86.7	20031026	33.8867	-118.49	0.104	0.08828
33	200201	86.7	20020131	33.8867	-118.4883	6.23	0.02636
33	200004	86.7	20000414	33.89	-118.49	3.586	0.2431
33	200104	86.7	20010413	33.89	-118.4883	3.907	0.49323

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
33	200001	86.7	20000115	33.8883	-118.49	2.378	0.51464
33	200204	86.7	20020403	33.8883	-118.49	3.002	0.27101
33	200307	86.7	20030722	33.8917	-118.49	0.194	0.05063
35	200007	93.3	20000629	32.68	-117.8733	0	0.01705
35	200107	86.7	20010717	33.8267	-118.6267	0.034	0.06245
35	200207	93.3	20020702	32.68	-117.875	0	0.03688
35	200104	93.3	20010406	32.6817	-117.875	1.023	0.43282
35	200101	93.3	20010108	32.68	-117.8733	0.049	0.01858
35	200101	90	20010114	33.2517	-118.2483	1.117	0.10859
35	200104	90	20010412	33.2517	-118.2533	1.912	0.4188
35	200104	86.7	20010413	33.825	-118.6267	0.074	0.13825
35	200211	90	20021116	33.2533	-118.25	0.033	0.01649
35	200007	86.7	20000705	33.8233	-118.6283	0	0.02634
35	200211	93.3	20021111	32.6833	-117.8683	0	0.00222
35	200211	86.7	20021116	33.825	-118.625	0	0.00459
35	200010	93.3	20001013	32.6867	-117.875	0	0.01749
35	200204	86.7	20020403	33.8267	-118.6217	0.103	0.19329
35	200010	90	20001018	33.2517	-118.25	0	0.04595
35	200201	93.3	20020124	32.6783	-117.87	0.585	0.15641
35	200201	90	20020130	33.2533	-118.25	0.305	0.08812
35	200204	93.3	20020328	32.68	-117.8733	0.118	0.83053
35	200010	86.7	20001019	33.825	-118.6317	0.03	0.03944
35	200101	86.7	20010114	33.8233	-118.6283	0.265	0.07414
35	200207	86.7	20020708	33.8233	-118.63	0	0.0049

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
35	200107	90	20010716	33.2533	-118.255	0.036	0.00906
35	200110	93.3	20011025	32.68	-117.8733	0.094	0.01341
35	200110	90	20011030	33.2517	-118.25	0.189	0.29997
35	200207	90	20020708	33.2517	-118.25	0.243	0.01079
35	200204	90	20020402	33.2483	-118.2517	0.39	0.16839
35	200110	86.7	20011031	33.8217	-118.625	0.006	0.00215
35	200107	93.3	20010710	32.68	-117.8733	0.014	0.06696
35	200201	86.7	20020131	33.8217	-118.6283	1.064	0.25693
35	200307	93.3	20030717	32.6767	-117.8733	0.008	0.01221
35	200310	90	20031026	33.2517	-118.25	0.068	0.02961
35	200004	93.3	20000408	32.6817	-117.8733	0.471	1.81819
35	200302	93.3	20030131	32.68	-117.8733	0.156	0.12848
35	200404	93.3	20040323	32.68	-117.8733	0.27	0.1075
35	200304	86.7	20030410	33.8233	-118.6233	0.022	0.06279
35	200001	90	20000114	33.25	-118.2517	1.204	0.08954
35	200401	93.3	20040106	32.6817	-117.8717	0.035	0.01303
35	200404	86.7	20040329	33.8233	-118.6283	0.538	0.13384
35	200310	86.7	20031026	33.825	-118.6267	0.035	0.00876
35	200004	90	20000413	33.2483	-118.2517	0.279	0.65196
35	200304	90	20030410	33.2517	-118.25	0.098	0.08967
35	200404	90	20040329	33.2517	-118.255	2.185	0.16435
35	200304	93.3	20030405	32.68	-117.8717	0.59	0.02995
35	200307	90	20030722	33.2517	-118.2483	0	0.0123
35	200307	86.7	20030722	33.8233	-118.63	0.004	0.01683

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
35	200004	86.7	20000414	33.825	-118.6333	0.336	0.23539
35	200401	90	20040111	33.2533	-118.2483	0.786	0.03735
35	200302	86.7	20030206	33.8233	-118.63	1.024	0.21647
35	200001	86.7	20000115	33.8233	-118.6283	0.047	0.03325
35	200302	90	20030205	33.2517	-118.25	0.4	0.05714
35	200401	86.7	20040112	33.8217	-118.6283	0.088	0.10567
35	200001	93.3	20000108	32.68	-117.8733	0.043	0.03011
35	200310	93.3	20031020	32.6783	-117.8767	0.005	0.09513
37	200004	90	20000413	33.185	-118.3867	1.716	0.58853
37	200101	90	20010113	33.185	-118.3867	0.725	0.05423
37	200201	90	20020130	33.185	-118.3867	0.388	0.08117
37	200304	90	20030409	33.185	-118.3867	0.045	0.04456
37	200401	90	20040111	33.185	-118.385	0.258	0.01343
37	200404	90	20040328	33.185	-118.3867	1.337	0.0743
37	200207	90	20020708	33.185	-118.385	0.632	0.00527
37	200211	90	20021116	33.1867	-118.39	0.172	0.00687
37	200110	90	20011030	33.185	-118.3867	0.033	0.02889
37	200204	90	20020402	33.1833	-118.39	0.268	0.12247
37	200107	90	20010716	33.185	-118.3883	0.182	0.10984
37	200310	90	20031025	33.185	-118.3883	0	0.03728
37	200001	90	20000114	33.1867	-118.3883	0.833	0.01388
37	200302	90	20030205	33.1867	-118.3867	1.318	0.19191
37	200104	90	20010412	33.185	-118.3883	0.018	0.03874
40	200401	86.7	20040112	33.6567	-118.975	0.928	0.24887

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
40	200101	86.7	20010114	33.6567	-118.9767	0.937	0.24087
40	200107	93.3	20010711	32.515	-118.21	0	0.02333
40	200204	86.7	20020403	33.66	-118.9733	0.17	0.31363
40	200004	86.7	20000414	33.6567	-118.9767	0.141	0.10193
40	200201	93.3	20020125	32.5133	-118.2133	0.426	0.05972
40	200110	86.7	20011031	33.6667	-118.97	0.108	0.04208
40	200001	93.3	20000108	32.5133	-118.21	0.32	0.01826
40	200107	86.7	20010717	33.6567	-118.975	0.03	0.01625
40	200310	86.7	20031026	33.6583	-118.9733	0.437	0.01651
40	200404	86.7	20040330	33.6567	-118.975	1.247	0.1003
40	200201	86.7	20020131	33.6617	-118.975	0.961	0.13731
40	200310	93.3	20031021	32.515	-118.2117	0	0.00421
40	200110	93.3	20011026	32.5133	-118.2133	0.012	0.02052
40	200307	93.3	20030718	32.515	-118.2133	0	0.004
40	200207	93.3	20020703	32.515	-118.2133	0.038	0.02396
40	200211	93.3	20021111	32.5117	-118.215	0.004	0.01503
40	200302	86.7	20030206	33.6567	-118.975	0.726	0.22978
40	200104	86.7	20010413	33.6567	-118.975	0.149	0.21091
40	200004	93.3	20000408	32.515	-118.21	0.71	0.27711
40	200007	93.3	20000630	32.5133	-118.2117	0.018	0.01349
40	200101	93.3	20010108	32.5133	-118.2133	0.023	0.0117
40	200302	93.3	20030131	32.5133	-118.2133	0.392	0.04986
40	200404	93.3	20040324	32.515	-118.2133	0.558	0.33938
40	200001	86.7	20000115	33.6583	-118.9767	0.094	0.04813

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
40	200207	86.7	20020709	33.6567	-118.9767	0.016	0.0026
40	200304	86.7	20030411	33.6567	-118.9733	0.076	0.09971
40	200304	93.3	20030405	32.5133	-118.2133	1.155	0.24554
40	200204	93.3	20020329	32.515	-118.215	0.24	0.47034
40	200104	93.3	20010407	32.515	-118.215	1.794	0.89373
40	200010	86.7	20001020	33.655	-118.9767	0	0.0095
40.6	200101	83.3	20010119	34.225	-119.415	31.49	0.49069
40.6	200007	83.3	20000709	34.225	-119.4117	10.36	0.04274
40.6	200211	83.3	20021121	34.2233	-119.41	2.841	0.02525
40.6	200404	83.3	20040403	34.225	-119.4133	1.344	0.06803
40.6	200004	83.3	20000418	34.225	-119.4117	6.866	0.55437
40.6	200201	83.3	20020205	34.2267	-119.4117	39.65	0.29289
40.6	200302	83.3	20030210	34.225	-119.4117	15.54	0.08052
40.6	200107	83.3	20010722	34.2267	-119.41	4.615	0.11734
40.6	200110	83.3	20011104	34.2217	-119.4117	2.321	0.04769
40.6	200204	83.3	20020408	34.2267	-119.415	1.118	0.11923
40.6	200010	83.3	20001025	34.225	-119.4133	4.222	0.12841
42	200104	83.3	20010419	34.1783	-119.5067	0.071	0.01939
42	200211	83.3	20021121	34.185	-119.525	0.444	0.01643
42	200207	83.3	20020713	34.1783	-119.5083	1.432	0.0172
42	200401	83.3	20040116	34.1817	-119.51	1.45	0.05266
42	200307	83.3	20030726	34.1767	-119.5083	1.179	0.00631
42	200110	83.3	20011104	34.175	-119.5033	0.638	0.03955
42	200010	83.3	20001025	34.1783	-119.5117	1.062	0.23705

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
42	200007	83.3	20000709	34.1767	-119.5083	0.229	0.00976
42	200001	83.3	20000119	34.1767	-119.5067	0.254	0.03294
42	200304	83.3	20030415	34.1783	-119.5083	1.054	0.00556
42	200201	83.3	20020205	34.175	-119.5133	1.543	0.0951
42	200204	83.3	20020408	34.175	-119.5083	0.159	0.04624
42	200101	83.3	20010119	34.175	-119.515	7.221	0.16492
42	200404	83.3	20040403	34.1817	-119.5083	1.589	0.02038
42	200302	83.3	20030210	34.1783	-119.5083	0.419	0.35554
42	200004	83.3	20000418	34.1783	-119.5083	0.298	0.25346
42	200107	83.3	20010722	34.1783	-119.5083	0.927	0.06332
42	200310	83.3	20031031	34.1783	-119.51	0.331	0.02003
45	200404	93.3	20040324	32.3467	-118.5533	1.029	0.5019
45	200104	93.3	20010407	32.3483	-118.5567	0.425	0.15595
45	200104	86.7	20010414	33.49	-119.315	0.06	0.10534
45	200401	90	20040111	32.9183	-118.9367	0.167	0.05429
45	200001	90	20000114	32.915	-118.9317	0.124	0.03429
45	200107	90	20010716	32.92	-118.9333	0	0.0046
45	200401	93.3	20040106	32.3483	-118.5533	0.074	0.0131
45	200001	86.7	20000115	33.49	-119.3183	0.169	0.07987
45	200404	86.7	20040330	33.4883	-119.3167	0.607	0.11005
45	200101	90	20010113	32.92	-118.935	0.04	0.02359
45	200107	86.7	20010718	33.49	-119.3183	0.005	0.09083
45	200104	90	20010412	32.9183	-118.9367	2.641	0.03974
45	200404	90	20040328	32.9183	-118.935	13.34	1.08624

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
45	200101	93.3	20010108	32.35	-118.5533	0.121	0.02101
45	200207	90	20020707	32.9183	-118.9367	0	0.01034
45	200010	86.7	20001020	33.4933	-119.3167	0.019	0.15476
45	200201	86.7	20020131	33.4917	-119.3167	1.245	0.20992
45	200304	93.3	20030405	32.3433	-118.5733	0.346	0.07148
45	200204	90	20020402	32.9183	-118.935	0.284	0.07448
45	200304	90	20030409	32.9183	-118.935	0.354	0.05375
45	200204	93.3	20020329	32.3467	-118.555	0.457	0.09853
45	200307	86.7	20030723	33.4917	-119.3183	0.005	0.0045
45	200004	90	20000413	32.9183	-118.9383	3.043	0.21888
45	200204	86.7	20020404	33.4917	-119.3183	0.318	0.29914
45	200007	93.3	20000630	32.3467	-118.5533	0.025	0.0098
45	200302	93.3	20030131	32.3467	-118.5517	0.095	0.00664
45	200207	93.3	20020703	32.3467	-118.5533	0	0.00509
45	200302	90	20030205	32.9183	-118.9367	0.183	0.05285
45	200004	93.3	20000408	32.3483	-118.5517	1.27	0.09195
45	200302	86.7	20030206	33.49	-119.3183	0.801	0.12821
45	200211	90	20021115	32.9183	-118.94	0	0.00812
45	200304	86.7	20030411	33.49	-119.3183	0.699	0.13525
45	200310	86.7	20031027	33.4917	-119.32	0.104	0.00433
45	200110	90	20011030	32.9183	-118.935	0.004	0.01101
45	200310	93.3	20031021	32.3517	-118.55	0.019	0.01405
45	200110	93.3	20011026	32.3517	-118.5567	0.019	0.04278
45	200110	86.7	20011031	33.4933	-119.3133	0.139	0.03037

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
45	200401	86.7	20040112	33.4917	-119.32	0.678	0.10433
45	200004	86.7	20000414	33.4933	-119.3217	0.047	0.16847
45	200001	93.3	20000108	32.3417	-118.555	0.179	0.0416
45	200211	86.7	20021117	33.49	-119.3133	0.049	0.11366
45	200010	93.3	20001013	32.345	-118.555	0	0.01353
45	200101	86.7	20010115	33.49	-119.3183	0.187	0.75
45	200201	90	20020130	32.9183	-118.935	0.783	0.27105
45	200010	90	20001018	32.91	-118.9167	0.009	0.01417
45	200307	93.3	20030718	32.3467	-118.555	0	0.00414
45	200201	93.3	20020125	32.3517	-118.5533	0.656	0.58265
45	200310	90	20031025	32.9183	-118.9367	0	0.00801
50	200004	93.3	20000408	32.1817	-118.8883	0.188	0.13832
50	200101	93.3	20010108	32.1767	-118.8917	0.253	0.01082
50	200001	93.3	20000108	32.18	-118.89	0.489	0.07216
50	200010	86.7	20001020	33.315	-119.6617	0.107	0.14298
50	200007	93.3	20000630	32.185	-118.8833	0.004	0.0173
50	200001	86.7	20000115	33.3233	-119.6583	0.269	0.5374
50	200004	86.7	20000414	33.3233	-119.6633	0.935	0.37068
50	200101	86.7	20010115	33.3233	-119.6633	0.016	0.7055
50	200010	93.3	20001013	32.18	-118.8933	0	0.0262
50	200302	93.3	20030131	32.1817	-118.8917	0.04	0.02757
50	200204	86.7	20020404	33.325	-119.6583	0.014	0.55775
50	200204	93.3	20020329	32.18	-118.89	0.693	0.62833
50	200201	86.7	20020131	33.3267	-119.6617	0.764	2.45677

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
50	200207	86.7	20020709	33.3233	-119.6633	0.008	0.00787
50	200207	93.3	20020703	32.18	-118.8917	0	0.00479
50	200110	93.3	20011026	32.1817	-118.885	0.017	0.0129
50	200211	93.3	20021111	32.18	-118.895	0.01	0.00203
50	200110	86.7	20011101	33.3283	-119.6567	0.126	0.01581
50	200201	93.3	20020125	32.1783	-118.8933	0.442	0.22537
50	200302	86.7	20030206	33.325	-119.6617	0.024	1.11312
50	200211	86.7	20021117	33.3217	-119.6683	0.088	0.10417
50	200107	93.3	20010711	32.1817	-118.89	0.207	0.00902
50	200304	93.3	20030405	32.18	-118.8933	0.246	0.1763
50	200307	93.3	20030718	32.1783	-118.8933	0.008	0.00416
50	200107	86.7	20010718	33.3233	-119.665	0.018	0.13781
50	200104	86.7	20010414	33.3217	-119.6617	0.192	0.28763
50	200404	93.3	20040324	32.1817	-118.8983	0.263	0.06164
50	200401	86.7	20040112	33.325	-119.6633	0.015	3.24061
50	200304	86.7	20030411	33.3233	-119.6633	0.158	0.44993
50	200404	86.7	20040330	33.3233	-119.66	3.059	0.56258
50	200104	93.3	20010407	32.1783	-118.8933	0.255	0.07347
51	200211	83.3	20021121	33.88	-120.1367	0.696	0.00749
51	200001	83.3	20000119	33.8767	-120.1367	0.781	0.44879
51	200010	83.3	20001025	33.8783	-120.135	1.238	0.1027
51	200207	83.3	20020713	33.8783	-120.1333	0.299	0.00389
51	200304	83.3	20030415	33.8783	-120.1333	0	0.03096
51	200104	83.3	20010417	33.88	-120.1367	0.134	0.2767

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
51	200007	83.3	20000709	33.8783	-120.1333	0.034	0.00423
51	200302	83.3	20030210	33.8783	-120.135	0.226	0.11719
51	200401	83.3	20040116	33.88	-120.135	0.324	0.26533
51	200004	83.3	20000418	33.8767	-120.135	0.7	0.13272
51	200404	83.3	20040403	33.8783	-120.1383	0.527	0.1718
51	200107	83.3	20010722	33.88	-120.1383	0.461	0.03182
51	200201	83.3	20020205	33.875	-120.1317	0.976	1.47159
51	200204	83.3	20020408	33.8783	-120.135	0.062	0.26493
51	200110	83.3	20011104	33.8783	-120.135	0.728	0.03008
51	200101	83.3	20010119	33.8783	-120.135	0.684	1.47903
53	200110	90	20011030	32.6483	-119.4933	0.013	0.01288
53	200004	90	20000412	32.6517	-119.4817	0.268	0.60546
53	200101	90	20010113	32.65	-119.4817	0.014	0.00701
53	200401	90	20040110	32.6517	-119.4817	0.035	0.01098
53	200302	90	20030204	32.6517	-119.48	0.079	0.13786
53	200001	90	20000112	32.65	-119.4817	0.687	0.02146
53	200211	90	20021115	32.655	-119.48	0	0.00457
53	200304	90	20030409	32.6517	-119.4817	0.337	0.90362
53	200107	90	20010716	32.65	-119.4817	0.119	0.05108
53	200307	90	20030721	32.6533	-119.4817	0.004	0.00862
53	200310	90	20031025	32.6533	-119.485	0.002	0.01272
53	200404	90	20040328	32.6533	-119.4817	0.093	0.33685
53	200207	90	20020707	32.6517	-119.4817	0	0.02943
53	200201	90	20020129	32.6517	-119.4817	18.19	0.88723

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
53	200104	90	20010412	32.6533	-119.48	0.219	0.12615
53	200204	90	20020402	32.6533	-119.4867	0.518	0.66613
53	200010	90	20001018	32.6533	-119.4833	0.007	0.0217
55	200104	83.3	20010417	33.745	-120.41	0.269	0.02524
55	200001	83.3	20000119	33.745	-120.4183	0.053	0.13565
55	200107	86.7	20010718	33.1533	-120.0083	0	0.02209
55	200404	93.3	20040324	32.0133	-119.2333	0.122	0.10179
55	200310	83.3	20031030	33.745	-120.4133	0.023	0.00188
55	200004	83.3	20000418	33.745	-120.41	0.552	0.10175
55	200107	83.3	20010721	33.7467	-120.41	0	0.03697
55	200401	86.7	20040112	33.155	-120.0067	0.008	0.02421
55	200310	86.7	20031027	33.16	-120.0033	0.022	0.00432
55	200401	93.3	20040106	32.0133	-119.235	0	0.01338
55	200001	93.3	20000108	32.0067	-119.235	0.056	0.00931
55	200310	93.3	20031021	32.0117	-119.2333	0	0.01662
55	200404	86.7	20040330	33.1533	-120.0033	1.535	0.10738
55	200401	83.3	20040116	33.7433	-120.4067	0.273	0.02706
55	200307	86.7	20030723	33.155	-120.015	0	0.00863
55	200001	86.7	20000115	33.155	-120.0067	0.182	0.03105
55	200404	83.3	20040403	33.745	-120.41	0.533	0.15093
55	200104	93.3	20010407	32.015	-119.23	0.335	0.30361
55	200104	86.7	20010414	33.1583	-120.0033	0.246	0.08349
55	200110	86.7	20011101	33.16	-119.9983	0.013	0.02183
55	200204	83.3	20020407	33.7417	-120.41	0.265	0.11717

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
55	200010	86.7	20001020	33.1583	-120.0067	0	0.00683
55	200204	86.7	20020404	33.1567	-120.0067	0.052	0.03011
55	200204	93.3	20020329	32.0133	-119.2317	0.34	0.14254
55	200010	83.3	20001025	33.745	-120.415	0.013	0.03442
55	200201	86.7	20020201	33.1567	-120.015	0.883	0.63858
55	200201	83.3	20020204	33.7467	-120.4117	0.884	0.32709
55	200207	83.3	20020712	33.7467	-120.4133	0	0.00511
55	200007	93.3	20000630	32.0133	-119.2333	0.005	0.0045
55	200110	93.3	20011026	32.0133	-119.2333	0.019	0.00486
55	200207	93.3	20020703	32.0133	-119.2333	0.009	0.01765
55	200101	86.7	20010115	33.1517	-119.9983	0.259	0.0413
55	200201	93.3	20020125	32.0133	-119.2317	12.18	3.28815
55	200304	93.3	20030405	32.0133	-119.2333	0.384	0.64798
55	200007	83.3	20000709	33.745	-120.41	0.009	0.01834
55	200211	93.3	20021111	32.0117	-119.2267	0.008	0.01241
55	200101	83.3	20010119	33.745	-120.41	0.063	0.02716
55	200004	93.3	20000408	32.0133	-119.2333	0.863	0.17257
55	200302	83.3	20030209	33.7433	-120.4117	0.184	0.16513
55	200110	83.3	20011104	33.7417	-120.41	0.135	0.00845
55	200302	86.7	20030206	33.1567	-120.005	0.053	0.03626
55	200302	93.3	20030131	32.0133	-119.2333	0.024	0.05798
55	200107	93.3	20010711	32.0183	-119.2317	0.045	0.03388
55	200304	83.3	20030415	33.745	-120.41	0.06	0.05984
55	200304	86.7	20030411	33.1533	-120.005	0.494	0.15773

Table 7. Determination of the Number of Ichthyoplankton Eggs and Larvae from CALCOFI Data

CalCOFI Station	Cruise Number	CalCOFI Line	Date (YYYYMMDD)	Latitude	Longitude	Fish Eggs (m^3 Water)	Fish Larvae (m^3 Water)
55	200004	86.7	20000414	33.1583	-120.0067	0.138	0.27032
55	200010	93.3	20001014	32.01	-119.2333	0.011	0.03187
Total egg and larvae for all stations per cubic meter of water						**347.42**	**61.94**
Average egg and larvae per 386 samples						**0.9000**	**0.1605**
Average egg and larvae per 1 million gallons of seawater						**3407.06**	**607.44**

Table 8. Density and Entrainment Estimates for Ichthyoplankton – FSRU Operation

Data Source	Average Number per Cubic Meter		Average Number per Million Gallons of Seawater		Number Entrained per Day at Normal Flow-FSRU (4.17 MGD)	
	Actual	Adjusted	Actual	Adjusted	Actual	Adjusted
Fish Eggs (44 samples)	0.9000	2.70	3,407	10,221	14,235	42,705
Fish Larvae (91 samples)	0.1605	0.4815	607	1,821	2,538	7,614
Combined (eggs + larvae)	1.0605	3.1815	4,014	12,042	16,773	50,319

Note: Actual data are from January through March, 2000 through 2004. Adjusted columns represent use of a multiplier of 3, as provided by N. Thompson, NOAA memo, February 18, 2004.

Table 9a. Overall Abundance for Each Larval Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Larval Abundance	Special Status
Sebastes spp.	205755.34	EFH
Stenobrachius leucopsarus	184971.65	--
Engraulis mordax	156311.46	EFH
Merluccius productus	151607.11	EFH
Leuroglossus stilbius	144910.52	--
Bathylagus ochotensis	132160.16	--
Sebastes jordani	102983.23	--
Citharichthys sordidus	96251.93	--
Citharichthys stigmaeus	61986.04	--
Tarletonbeania crenularis	54716.76	--
Sebastes paucispinis	54501.79	EFH
Sardinops sagax	41083.26	EFH
Protomyctophum oodie	40152.13	--
Nannobrachium ritteri	28682.52	--
Rathbunella spp.	23782.57	--
Trachurus symmetricus	23366.21	--
Rhinogobiops nicholsii	22360.28	--
Sebastes diploproa	20108.98	EFH
Triphoturus mexicanus	17744.00	--
Sebastes aurora	16376.68	EFH
Lyopsetta exilis	13501.16	--
Cyclothone signata	12753.47	--
Argentina sialis	12624.35	--
Trachipterus altivelis	12447.00	--
Oxylebius pictus	12376.52	--
Cryptotrema corallinum	11717.17	--
Bathylagus wesethi	11092.77	---
Diogenichthys atlanticus	10957.86	--
Genyonemus lineatus	10918.38	--
Icelinus quadriseriatus	10216.18	--
Scomber japonicus	10003.78	EFH
Symbolophorus californiensis	9215.74	--
Nannobrachium spp.	8399.72	--
Paralichthys californicus	7764.37	--
Argyropelecus sladeni	7741.39	--
Scorpaenichthys marmoratus	7686.35	EFH

Table 9a. Overall Abundance for Each Larval Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Larval Abundance	Special Status
Zaniolepis latipinnis	7091.89	--
Icichthys lockingtoni	6687.08	--
Parophrys vetulus	6362.33	--
Cataetyx rubrirostris	6068.77	--
Nansenia candida	5873.44	--
Gibbonsia spp.	5598.74	--
Sebastes levis	5406.25	EFH
Cololabis saira	4850.40	--
Ichthyococcus irregularis	4495.37	--
Melamphaes lugubris	4443.51	--
Typhlogobius californiensis	4329.91	--
Lestidiops ringens	4284.06	--
Pleuronichthys verticalis	4224.10	--
Lepidogobius lepidus	3853.93	--
Danaphos oculatus	3769.36	--
Microstoma spp.	3717.05	--
Benthalbella oodie	3487.50	--
Xeneretmus latifrons	3199.96	--
Melamphaes parvus	3033.21	--
Brosmophycis marginata	2818.20	--
Artedius lateralis	2746.28	--
Odontopyxis trispinosa	2746.28	--
Pleuronichthys ritteri	2634.04	--
Ophidion scrippsae	2628.78	--
Ruscarius creaseri	2618.63	--
Sebastes oodie	2541.98	EFH
Seriphus politus	2541.41	--
Zaniolepis frenata	2519.34	--
Stomias atriventer	2227.83	--
Diaphus spp.	2201.63	--
Rathbunella alleni	1948.12	--
Stichaeidae	1943.28	--
Icosteus aenigmaticus	1899.90	--
Chilara taylori	1892.67	--
Liparis mucosus	1819.31	--
Citharichthys spp.	1809.12	--

Table 9a. Overall Abundance for Each Larval Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Larval Abundance	Special Status
Ilypnus gilberti	1672.39	--
Hypsoblennius jenkinsi	1505.99	--
Oxyjulis californica	1368.31	--
Chauliodus macouni	1343.56	--
Argyropelecus lychnus	1317.02	--
Neoclinus stephensae	1287.12	--
Leptocottus armatus	1143.01	--
Atherinopsis californiensis	1102.01	--
Argyropelecus affinis	1052.99	--
Dolichopteryx longipes	1026.04	--
Vinciguerria lucetia	935.64	--
Lythrypnus dalli	897.33	--
Semicossyphus pulcher	828.70	--
Hypsoblennius spp.	647.87	--
Lepidopsetta bilineata	614.60	--
Glyptocephalus zachirus	597.07	--
Macroramphosus gracilis	543.55	--
Lythrypnus zebra	541.24	--
Ruscarius meanyi	502.40	--
Tetragonurus cuvieri	423.44	--
Orthonopias triacis	394.33	--
Neoclinus spp.	388.76	--
Hygophum reinhardtii	348.07	--
Paralabrax spp.	313.13	--
Anisotremus davidsoni	307.60	--
Idiacanthus antrostomus	278.68	--
Sphyraena argentea	266.34	--
Peprilus simillimus	239.69	--
Sebastolobus spp.	233.33	--
Scopelarchus analis	219.48	--
Microstomus pacificus	216.56	--
Chromis punctipinnis	209.48	--
Symphurus atricaudus	159.29	--
Ceratoscopelus townsendi	146.15	--
Plectobranchus evides	117.20	--
Nannobrachium regale	114.96	--

Table 9a. Overall Abundance for Each Larval Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Larval Abundance	Special Status
Mugil cephalus	113.87	--
Arctozenus risso	102.43	--
Bathylagus pacificus	69.12	--
Diogenichthys laternatus	56.89	--
Atractoscion nobilis	40.84	--

Notes: EFH = Essential Fish Habitat

Special status includes any species identified as threatened or endangered under state and federal guidelines.

Table 9b. Overall Larval Abundance for Special Status Species in the Project Quadrat

Species	Overall Larval Abundance	Special Status
Sebastes spp.	205755.34	EFH
Engraulis mordax	156311.46	EFH
Merluccius productus	151607.11	EFH
Sebastes paucispinis	54501.79	EFH
Sardinops sagax	41083.26	EFH
Sebastes diploproa	20108.98	EFH
Sebastes aurora	16376.68	EFH
Scomber japonicus	10003.78	EFH
Scorpaenichthys marmoratus	7686.35	EFH
Sebastes levis	5406.25	EFH
Sebastes oodie	2541.98	EFH
Total larval abundance for special status species 671,382.98		

Notes: EFH = Essential Fish Habitat

Special status includes any species identified as threatened or endangered under state and federal guidelines and those assigned as part of essential fish habitat.

Table 9c. Overall Abundance for Each Egg Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Egg Abundance	Special Status
Engraulis mordax	995204.94	EFH
Sebastes spp.	822770.19	EFH
Merluccius productus	628083.32	EFH
Leuroglossus stilbius	617147.31	--
Stenobrachius leucopsarus	589116.29	--
Citharichthys sordidus	438943.48	--
Sebastes jordani	431186.79	EFH
Bathylagus ochotensis	392481.49	--
Genyonemus lineatus	316459.03	--
Citharichthys stigmaeus	264731.90	--
Cololabis saira	129963.18	--
Zaniolepis latipinnis	125356.11	--
Protomyctophum crockeri	117283.75	--
Tarletonbeania crenularis	101736.35	--
Triphoturus mexicanus	84809.43	--
Scomber japonicus	77819.25	EFH
Trachurus symmetricus	77205.03	--
Sardinops sagax	76069.25	EFH
Paralichthys californicus	68648.97	--
Ophidion scrippsae	65446.70	--
Lyopsetta exilis	58508.35	--
Sebastes paucispinis	57862.21	EFH
Parophrys vetulus	56858.17	--
Hypsoblennius spp.	55182.37	--
Icelinus quadriseriatus	54317.71	--
Argentina sialis	49061.47	--
Nannobrachium ritteri	46996.91	--
Trachipterus altivelis	46125.09	--
Pleuronichthys verticalis	41903.26	--
Neoclinus stephensae	30708.09	--
Bathylagus wesethi	29570.69	--
Rhinogobiops nicholsii	27633.17	--
Cataetyx rubrirostris	22583.65	--
Zaniolepis frenata	22496.48	--
Seriphus politus	21974.09	--
Typhlogobius californiensis	21845.88	--
Argyropelecus sladeni	19120.80	--

Table 9c. Overall Abundance for Each Egg Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Egg Abundance	Special Status
Lepidogobius lepidus	18971.73	--
Pleuronichthys ritteri	17904.32	--
Diogenichthys atlanticus	15914.40	--
Hypsoblennius jenkinsi	15621.18	--
Nannobrachium spp.	15504.18	--
Sebastes aurora	14494.68	EFH
Sebastes diploproa	12626.77	EFH
Chauliodus macouni	12408.35	--
Symbolophorus californiensis	11799.54	--
Icichthys lockingtoni	11756.43	--
Brosmophycis marginata	11306.42	--
Leptocottus armatus	11261.87	--
Danaphos oculatus	10923.18	--
Scorpaenichthys marmoratus	10234.16	EFH
Ilypnus gilberti	9970.06	--
Ichthyococcus irregularis	9754.78	--
Oxylebius pictus	9501.23	--
Rathbunella alleni	9001.67	--
Sebastes levis	8821.22	EFH
Ruscarius creaseri	7962.01	--
Citharichthys spp.	7569.39	--
Benthalbella dentata	6945.10	--
Sphyraena argentea	6626.89	--
Paralabrax spp.	6625.91	--
Stomias atriventer	6496.22	--
Cryptotrema corallinum	6233.55	--
Xeneretmus latifrons	5782.97	--
Lestidiops ringens	5334.59	--
Hygophum reinhardtii	4807.02	--
Microstoma spp.	4730.17	--
Liparis mucosus	4704.59	--
Neoclinus spp.	4685.73	--
Atherinopsis californiensis	4351.67	--
Sebastes goodei	4304.62	--
Lythrypnus dalli	4021.39	--
Icosteus aenigmaticus	3894.77	--
Anisotremus davidsoni	3728.82	--

Table 9c. Overall Abundance for Each Egg Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Egg Abundance	Special Status
Peprilus simillimus	3509.95	--
Vinciguerria lucetia	3480.31	--
Artedius lateralis	3465.81	--
Odontopyxis trispinosa	3465.81	--
Rathbunella spp.	3335.48	--
Stichaeidae	3171.83	--
Melamphaes parvus	3105.89	--
Dolichopteryx longipes	2962.24	--
Mugil cephalus	2755.36	--
Melamphaes lugubris	2744.84	--
Nansenia candida	2729.85	--
Ruscarius meanyi	2650.66	--
Gibbonsia spp.	2590.47	--
Argyropelecus lychnus	2177.10	--
Diaphus spp.	2003.92	--
Argyropelecus affinis	1914.51	--
Glyptocephalus zachirus	1869.84	--
Lepidopsetta bilineata	1700.10	--
Idiacanthus antrostomus	1324.36	--
Bathylagus pacificus	1209.93	--
Macroramphosus gracilis	1069.00	--
Arctozenus risso	1032.77	--
Chilara taylori	1006.96	--
Sebastolobus spp.	993.90	--
Atractoscion nobilis	919.29	--
Oxyjulis californica	603.21	--
Nannobrachium regale	525.53	--
Semicossyphus pulcher	423.40	--
Symphurus atricaudus	407.05	--
Lythrypnus zebra	405.95	--
Orthonopias triacis	332.06	--
Chromis punctipinnis	323.58	--
Cyclothone signata	199.53	--
Microstomus pacificus	170.99	--
Tetragonurus cuvieri	128.82	--
Scopelarchus analis	89.41	--
Ceratoscopelus townsendi	31.31	--

Table 9c. Overall Abundance for Each Egg Taxa in the Project Quadrat Identified Near Cabrillo Port

Species	Overall Egg Abundance	Special Status
Diogenichthys laternatus	16.24	--
Plectobranchus evides	0.00	--

Table 9d. Mean Egg Abundance for Special Status Species in the Project Quadrat

Species	Overall Egg Abundance	Special Status
Engraulis mordax	995204.94	EFH
Sebastes spp.	822770.19	EFH
Merluccius productus	628083.32	EFH
Sebastes jordani	431186.79	EFH
Scomber japonicus	77819.25	EFH
Sardinops sagax	76069.25	EFH
Sebastes paucispinis	57862.21	EFH
Sebastes aurora	14494.68	EFH
Sebastes diploproa	12626.77	EFH
Scorpaenichthys marmoratus	10234.16	EFH
Sebastes levis	8821.22	EFH
Total egg abundance for special status species	**3,135,172.78**	

Note: EFH = Essential Fish Habitat

Special status includes any species identified as threatened or endangered under state and federal guidelines and those assigned as part of essential fish habitat.